Efficacy of eFume and Bluefume (HCN) fumigation in eradicating elongate hemlock scale on Christmas trees

Gary Chastagner¹, Jill Sidebottom², Robert Jetton², <u>Spencer Walse³</u>, Stephen Corbett³

¹Washington State University, ²North Carolina State University, ³USDA ARS, San Joaquin Valley Agricultural Sciences Center Email: chastag@wsu.edu

Introduction

The elongate hemlock scale (EHS), *Fiorinia externa* Ferris, is an exotic, armored scale insect pest of hemlocks and other conifers. It is native to Japan and eastern Asia and was first detected in the U.S. in 1908 in Queens, NY. Since then, it has spread throughout most of the eastern U.S. and has become a key pest of the Christmas tree industry on true firs (*Abies* spp.) and Douglas-firs (*Pseudotsugae* spp.). Presence of EHS on cut trees and greenery has resulted in regulatory concerns in states where EHS is currently not found.







Approach

Efficacy tests were conducted on 2-yr-old **EHS-infested Fraser fir shoots and** postharvest crop tolerance tests were done on fumigated 2-yr-old shoots from 11 conifers species in 2020 and 8 conifer species in 2021. Each replicate consisted of a bundle of five shoots, which were fumigated in 28.32 L chambers at 10C. Checks consisted of non-fumigated bundles of shoots. The EF fumigations were done at multiple rates (5, 10, 20, 40, and 80 g/m³) for a period of one hour. A single rate of HCN (g/m³) was used, but the duration of fumigation treatments ranged from 0.5 to 4 hours. Non-fumigated bundles of shoots served as the checks.

Efficacy of the fumigation treatments was



Distribution of elongate hemlock scale in 2021. Source: Elongate Hemlock Scale | Extension | West Virginia University https://extension.wvu.edu > lawn-gardening-pests > pests. (5/27/22)

EHS has a complex life cycle and can overwinter in several developmental stages. It feeds on the underside of needles, making it difficult for producers to follow the extent of infestations. Feeding can result in yellow mottling, though this symptom is often limited in properly maintained, Fraser fir Christmas tree plantations. What is more readily observed are the waxy filaments produced by developing male scales. These will appear on the tops of needles as branches blow in the wind, a sign readily apparent through the summer during shearing and other production practices.



assessed by suspending infested shoots

above a sticky card at room temperature and counting the number of crawlers that fell onto the cards. The tolerance of conifers to the fumigation treatments was evaluated by rating needle loss (NL) and needle discoloration ND on shoots that were displayed in a room at 20C.

Results

Most crawlers emerged from non-fumigated infested shoots within a few days at room temperature. The efficacy of EF and HCN in killing EHS was rate and/or fumigation duration dependent. A 1 hr. exposure to HCN was as effective as a 2 or 4 hr. exposure in reducing the emergence of crawlers. Although, the highest rate of EF and exposure to HCN significantly reduced numbers of crawlers, none of these treatments eradicated the EHS. In addition, conifer species varied greatly in their tolerance to fumigation treatments. The high rate of EF was clearly phytotoxic to all the conifer species. It increased ND on all species, except Douglas-fir, and Increased NL on Balsam, Canaan, Fraser, Nikko, Nordmann and Turkish fir. EF at 20 g/m³ was sufficient to increase NL on Douglas-fir and European silver fir. EF did not increase NL on noble, Shasta, and white firs. Exposure of three species (Fraser, Grand and noble fir) to HCN did not increase NL. Exposure of Balsam fir to HCN for <u>>1</u> hrs increased NL, while Douglas-fir, Korean, Nordmann, and Turkish firs experienced increased NL when exposed to HCN for 2 or 4 hrs.







Only crawlers can move onto new plant material or allow the pest to spread to new regions. EHS overwinters as multiple life stages including gravid females, and eggs can hatch over an extended period of time once plant material is harvested in late fall and moved to warmer locations. Although not know to occur in the western U.S., in 2019 EHS was detected on Fraser fir Christmas trees that were shipped from North Carolina to a number of western states. Given the abundance of host material and the potential impact this pest would have on Christmas trees and forests in the PNW, regulatory agencies issued stop sale notifications and ordered infested trees to either be returned or destroyed.

Reducing The Spread of EHS

As 100% control of EHS is impossible in the field, the movement of Christmas tree and greenery products increase the risk that EHS will spread to areas in North America where EHS is not currently found. Since 2020 we have evaluated the effectiveness of postharvest ethyl formate (EF), sold as eFume, and hydrogen cyanide (HCN), sold as Bluefume, fumigations for killing EHS life stages on infested Fraser fir branches and determined the effects of these fumigants on the postharvest quality of commonly-grown Christmas tree species

Future Research

Given that neither EF nor HCN killed 100% of EHS, other alternative non-methyl bromide postharvest treatments need to be evaluated. Alternatives that may have the potential to control EHS, include Ethanedinitrile [EDN], which is still in the registration process with the USEPA; sulfuryl fluoride [SF]; or phosphine. Some of these, such as SF can be phytotoxic to green plants so the effects upon needle loss would also need to be investigated. Phosphine is more ideal for stationary longer-term storage and requires an initial cost in infrastructure to ensure no gas is lost during treatment. Depending on industry operations and logistics a more precise non-methyl bromide postharvest treatment schedule can be developed to reduce the risk of spreading EHS via the movement of Christmas trees and greenery products.

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