Elongate Hemlock Scale Crawler Risk Assessment:
Technical Report to Christmas Tree Promotion Board
Jill R. Sidebottom, December 18, 2020

Introduction: Cut Christmas trees are no longer living, and pests such as elongate hemlock scale (EHS) will eventually dry out and die. Preliminary research has indicated that crawlers, the only stage that can move to and infest a new host, emerge from infested branches for 35 to 40 days after harvest. After that, the material will no longer be able to transfer the pest to a new host. These observations were made with material that was immediately brought to room temperature and not stored as growers do during harvest. Most Christmas tree growers store their trees under shade outside where temperatures vary while a few palletize their trees and store them with refrigeration. A post-harvest interval study has been funded through a Specialty Crops Block Grant submitted from NCSU by Dr. Robert Jetton. However, preliminary information that would be helpful to this study still needed to be conducted.

Therefore, to support the Specialty Crops Block Grant, within tree and between tree variation in crawler release from cut Fraser fir trees and branches was conducted in 2019.

Materials and Methods: Twenty Fraser fir Christmas trees infested with EHS were cut and baled from an Ashe County farm on November 20, 2019. The next day, the crawler risk assessment experiment was set up in the Conifer Lab at the Mountain Horticulture Research Station in Waynesville. A single heavily infested branch with 2018 and 2019 growth was removed from each tree to compare crawler emergence from a branch vs the whole tree. To compare how tree drying affects crawler emergence, ten of the trees were left baled and suspended above the floor with cinder blocks while the other ten trees were unbaled and set up in wooden tree stands but left unwatered. The corresponding branch from all trees was draped over plastic pots that were 21 cm diameter and 15 cm deep.

A 7.6 × 12.7 cm yellow sticky card (Sensor® Cards, BASF Corporation) was placed to maximize the likelihood of capturing crawlers for all trees and branches. For the branches, cards were placed at the bottom of each pot 15 cm below the branch. In baled trees, a single card was placed in a location directly under the most infested portion of the tree at approximately 38 cm below the tree. In unbaled trees set up in stands, the most heavily infested branch was identified, and a single card was placed directly below it and attached to a branch with a clothespin and approximately 8 cm below the infested branch. Cards were replaced weekly and placed in the exact same location/orientation. Counts of crawlers were taken under a stereomicroscope on the following days:

- November 27 (1-7 days after cutting)
- December 4 (7-14 days)
- December 11 (14-21 days)
- December 18 (21-28 days)
- December 26 (28-36 days)
- January 2 (36-43 days)
- January 9 (43-50 days)
- January 15 (50-56 days)
- January 21 (56-62 days)
- January 28 (62-69 days)

Moisture content of trees and branches was monitored through the course of the experiment by removing shoots of current growth and comparing fresh weight to oven dried weight. Moisture content was determined the day that trees were cut, and in both baled and unbaled trees on November 27, December 4 and 18, and January 2.

Results & Discussion: All of the trees and/or their corresponding branches released crawlers (Table 1).

The total number of crawlers released through the course of the experiment varied greatly between trees and branches (Table 1). The total crawler count ranged from 0 to 303 among trees (average = 53.5 total crawlers, median = 13 total crawlers) and from 0 to 153 among branches (average = 20.7 total crawlers, median = 9.5 total crawlers). In addition, the trees that released the most crawlers did not necessarily also release the most crawlers from their corresponding branches. Therefore, it's important when conducting these types of studies to have a large enough sample size and to work with as heavily infested material as possible.

To determine crawler dispersal rate over time, crawler counts were converted to the percentage of the total crawlers observed for each sample date by dividing all the crawlers counted up to each date by the total at the end of the experiment (Figure 1). Crawlers released from trees over a 9-week period but only from a 5-week period from their corresponding branches.

The pattern of how quickly crawlers were released corresponds to how quickly branches and trees dried out. Branches dry out faster than trees, and trees in stands dried out faster than baled trees. If this theory is correct, than for trees had been maintained in stands with water could potentially release crawlers over an even longer period of time. Similar observations have been made with hemlock woolly adelgid – that more crawlers are released from branches cut from trees and left to dry out than from branches displayed in water.

Fraser fir Christmas trees are typically cut no earlier than the last week in October in North Carolina. From the earliest cut trees until Christmas is about 9 weeks. Therefore, it is possible that a discarded Christmas tree could release crawlers into the environment after Christmas. It is much less likely that this would occur from wreaths or roping.

It was not determined in this experiment if crawlers released at the end of the study were as capable of infesting a host as those released at the beginning of the study. And in fact, towards the end of the study, many crawlers had a dried out appearance. Due to this observation, in fall 2020, a similar experiment was set up at NC State University. Dr. Robert Jetton and his graduate student, Dominic Manz, are placing infested branches on Fraser fir seedlings weekly from cut trees to determine if crawlers can infest a host weeks after the tree was cut.

Table 1. Total crawlers observed over a 62-day period from trees and their corresponding branches.

Tree designation	Baled or in stand	Total crawlers observed from tree	Total crawlers observed from corresponding branch
1	Baled	6	29
2	Baled	26	49
3	Stand	279	13
4	Baled	11	5
5	Baled	21	22
6	Baled	12	3
7	Baled	1	5
8	Stand	49	0
9	Baled	14	0
10	Stand	12	33
11	Stand	0	8
12	Stand	303	153
13	Stand	2	24
14	Stand	4	4
15	Baled	25	0
16	Stand	1	17
17	Stand	92	7
18	Baled	188	30
19	Baled	15	1
20	Stand	8	11

Figure 1. Average percentage of the total crawlers observed over time and percent moisture content in baled trees and trees in stands as compared to their corresponding branches and branches from the host study conducted the previous year.