Western Blackheaded Budworm
Acleris gloverana (Walsingham)
Lepidoptera: Tortricidae

Objective: To develop a sampling plan that estimates the density of *A. gloverana* at three levels of fixed precision and relates density to predicted damage levels.

Abstract: Western blackheaded budworm, *Acleris gloverana* (Walsingham), is an occasional pest of western hemlock, *Tsuga heterophylla* (Raf.) Sarg., in the western US and Canada. A sequential estimation plan was developed to improve the efficiency of sampling *A. gloverana* eggs. Previous work described the relationship between egg density and defoliation levels of *A. gloverana* (Silver 1959), but it was labor intensive. The method described here would allow managers to efficiently estimate egg densities to predict defoliation levels of *A. gloverana*.

The fresh weight (or volume) of a 46-cm branch tip per tree is used as the sample unit for the estimation of density of eggs of *A. gloverana*. Branch weight is less variable among crown levels and cardinal points on the tree, and so fewer sample units are required than if using branch volume. The average time to select a tree, remove a sample, and process the sample is 21 minutes.

Sampling Procedure: Randomly sample one 46-cm branch tip per tree in the area of concern. Soak each branch individually in a 3,000 ml beaker of hot water for a maximum of 30 secs (Gray et al. 1973; see our summary in this volume). Soaking the branches for longer will remove all the foliage in addition to the eggs, requiring additional screening of the needles from the sample. Using tongs, agitate the branch sample in the water to ensure that all *A. gloverana* eggs are released from the foliage. Eggs will settle to the bottom of the beaker. Remove the sample branch and slowly pour the water containing the eggs into a 18.5-cm Buchner funnel. Rinse the beaker with additional water to ensure no eggs remain and pour this rinsate into the funnel as well. Vacuum filtrate the material through filter paper. A plexiglass ring can be used to weight the filter paper down and ensure that eggs stay on the upper surface of the paper. This ring should also be rinsed adequately and the rinsate filtered as well.

Count the number of *A. gloverana* eggs on the filter paper and divide the count by the fresh weight of the sampled branch. Sample a minimum of four trees as described above. Keep a cumulative tally of egg densities, rounding to the nearest egg per gram of fresh branch weight. Refer to Table 2 for the desired level of fixed precision and stop sampling once the cumulative egg density is equal to or exceeds the appropriate threshold. Compare the estimated density with Table 3 to determine the predicted defoliation class.

Notes: This method should only be used before serious defoliation has occurred in the tree. High levels of defoliation alter the distribution of needles, which are oviposition sites for this insect, within the tree crown. This changes the relationship between mean crowding and insect density and changes the relationship between required sample size and egg density at each level of fixed precision used.

Filter papers may be refrigerated or frozen for counting at a later date; store labeled filter papers between polyethylene sheets.

References:

Gray, T. G.; Shepherd, R. F.; Wood, C. S. 1973. A hot-water technique to remove insect eggs from foliage. Canadian Forest Service Bi-monthly Res. Notes 29: 29.

Silver, G. T. 1959. A method for sampling eggs of the blackheaded budworm. Journal of Forestry 57: 203-205.

Tables

Table 2. The cumulative egg densities per gram of fresh branch weight for different required sample sizes to attain allowable errors of 0.10 and 0.20. Sample densities are determined for each branch and accumulated. Stop sampling when the accumulated sample data equals or exceeds the egg density of the chosen allowable error.

Number of branches sampled	Enter accumulated sample data	Allowable error	
		0.20%	0.10%
		Accumulated egg densities per gram of fresh weight	
4		14	--
5		9	--
6		7	--
7		6	--
8		6	--
9		5	--
10		5	--
11		5	--
12		5	--
13		5	175
14		4	100
15		4	70
16		4	56
20		4	35
30		4	23
40		4	20
50		4	18

Table 3. Range of egg densities per branch and per gram of fresh branch weight for three defoliation classes.

Damage class	Number of eggs per 46-cm branch	Number of eggs per gram of fresh weight
Nil to light	0–26	0–1.40
Moderate	27–59	1.41–3.20
Severe	60 +	3.21 +

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