Western Spruce Budworm

Choristoneura occidentalis (Freeman)
Lepidoptera: Tortricidae

Cole, W. E. 1960. Sequential sampling in spruce budworm control projects. *Forest Science* 6: 51-59.

Objective: To develop a sequential sampling plan to estimate populations of *C. occidentalis* larvae before and after control techniques are applied.

Abstract: The western spruce budworm is the most destructive defoliator of Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco, in northwestern North America. The last three larval instars of *C. occidentalis* cause most of the defoliation of Douglas-fir. Epidemic populations can last 5-10 years in duration.

Intensive sampling of *C. occidentalis* is often required to determine if control measures are warranted and to determine if control was successful. A sampling method was developed to predict pre- and post-spray population levels of *C. occidentalis*. The pre-spray larval count was obtained by determining the number of larvae on a 38-cm twig collected from each of five trees per plot, on each of 10 plots. A total of 50 twigs was sampled. Populations were classified as Class I (light, ≤2 larvae per twig), Class II (medium, 3-5 larvae per twig) or Class III (heavy, ≥6 larvae per twig) prior to treatment. The post-spray larval count was obtained by sampling two twigs per tree in the same plots as the pre-spray count, for a total of 100 twigs sampled. Control was classified as either successful or unsuccessful if ≤0.35 or ≥0.50 larvae were found per twig, respectively. This type of sequential sample is suspected to improve predictions of *C. occidentalis* population levels before and after control is applied.

Sampling Procedure: To conduct the pre-spray survey, establish a plot every 100 m, for a total of 10 plots, along a transect running perpendicular to the proposed spray swath or across elevation contours in the block. The transect(s) should be placed in an area that is representative of the entire spray block. Collect one 38-cm twig from the mid-crown of each of five Douglas-fir trees per plot for each of 10 plots per transect line, for a total of 50 twigs sampled. Count the number of larvae found on each twig, adding the counts of successive twigs to the total. After sampling five twigs, compare the cumulative number of *C. occidentalis* larvae found with the values listed in Table 3. If the count falls between those listed for each class, then sample another five twigs and compare the cumulative count to the values listed in Table 3. Continue until a class designation is determined. If all 50 twigs have been sampled and no decision has been reached, then the infestation level is a combination of the two classifications (i.e., light-medium).

To conduct a post-spray survey, use the plots sampled for the pre-spray survey. Wait at least 10 days post-spray before conducting the sample to ensure maximum mortality of *C. occidentalis* larvae. Collect a maximum of two twigs from each of the sample trees, for a total of 100 twigs sampled. After the number of living larvae has been determined from the first 15 twigs, compare this number with the values listed in Table 4. Continue sampling, five twigs at a time, until the cumulative count falls below (satisfactory control) or rises above (unsatisfactory control) the numbers listed in Table 4. If after sampling 100 twigs no decision is reached, then the infestation is classified as being equal to 95% reduction.

Both types of sequential samples have a sampling error of 10%. The number of samples, sample trees and plots can be varied according to time and labor constraints.

Notes: Areas to be sprayed are selected by some other types of surveys, such as egg or overwintering second instar surveys (Wilson 1959, Waters 1974). The pre-spray sample occurs before the most damaging, fourth, fifth, and sixth instar *C. occidentalis* are present in the population.

References:

*Wilson, L. F. 1959. Branch "tip" sampling for determining abundance of spruce budworm egg masses. *Journal of Economic Entomology* 52: 618-621.

*Waters, W. E. 1974. Sequential sampling applied to forest insect surveys. In: *Proceedings of IUFRO/SAF/SUNY symposium on monitoring forest environment through successive sampling*. June 24-26, Syracuse, NY; 290-311.

Table 3. Sequential table for field use in precontrol sampling of spruce budworm larval populations.

No. of twigs	Cumulative number of budworm larvae				
	Class I	*Continue*	Class II	*Continue*	Class III
5	5		19-27		48
10	17		32-34		75
15	30		44-62		103
20	42		56-89		130
25	54		68-116		158
30	67		81-144		185
35	79		93-171		212
40	91		105-198		240
45	103		118-226		267
50	116		130-253		294

Table 4. Sequential table for field use in postcontrol sampling of spruce budworm larval populations.

Number of twigs examined	Cumulative number of budworm larvae Satisfactory vs. Unsatisfactory			
15	*Satisfactory Control*	---	*Continue Sampling*	12 *Unsatisfactory Control*
20		2		14
25		4		17
30		6		19
35		8		21
40		11		23
45		13		25
50		15		27
55		17		29
60		19		31
65		21		34
70		24		36
75		26		38
80		28		40
85		30		42
90		32		44
95		34		46
100		36		48