Spruce Bud Moth

Zeiraphera canadensis Mutuura & Freeman
Lepidoptera: Tortricidae

Régnière, J.; Boulet, B.; Turgeon, J. J. 1988. Sequential sampling plan with two critical levels for spruce bud moth (Lepidoptera: Tortricidae). Journal of Economic Entomology 81: 220-224.

Objective: To develop a sequential sampling plan for *Z. canadensis* in white spruce plantations based on larval density.

Abstract: Spruce bud moth, *Zeiraphera canadensis* Mutuura & Freeman, is a pest of white spruce, *Picea glauca* (Moench) Voss in eastern North America. Larvae tend to feed on the current year's growth in the upper crown, limiting damage to reduced growth and crown distortion. Damage is particularly important in plantations of white spruce, where reduced growth may postpone harvest for several years. Older larvae occasionally feed on the bark of tender twigs, which may predispose the tree to attack by wood boring insects and decay fungi. In the urban setting, unsightly feeding damage may be of a concern to homeowners.

The authors developed a sequential sampling plan with a 68% confidence level for *Z. canadensis* larvae based on two critical levels of two and eight larvae per sample.

Larvae per branch sample	Threshold density
$\mu \leq 2$	Low
$2 < \mu \leq 8$	Moderate
$\mu > 8$	High

Previous research used a critical level of 5 larvae per branch sample (Turgeon and Régnière 1987). Generally 20 branch samples were needed for larval densities near the lower critical level, but smaller sample sizes were required for most densities. Typically the plan took 1–2 hours to conduct in plantations where more than 1.5 larvae were found in each sample. At least 16 min were needed for a plantation when no spruce bud moth larvae are found on the minimum sample size of only five branches. Because larvae aggregate in the crown, excessively large sample sizes would be needed for confidence levels of 90–95%, which would make the plan impractical for most pest managers.

Sampling Procedure: Select white spruce trees at equally spaced intervals throughout the plantation. Randomly cut one 15-cm terminal branch from the upper third of the crown of each tree.

Count the number of third and fourth instars in each 15-cm branch sample as a cumulative tally. Compare the cumulative tally to Table 1. Counts can be classified as low, moderate, or high if the cumulative tally crosses the boundaries of the lower or upper critical zones. If the tally remains in a zone, continue sampling until 50 branch samples have been examined in the lower critical zone or 20 branch samples have been examined for the upper critical zone. If a maximum of 50 branch samples are examined in the lower critical zone, the population can be classified as low if n <100 larvae or as moderate if $n \geq 100$ larvae. If a maximum of 20 branch samples are examined in the upper critical zone, the population can be classified as moderate if n <160 larvae or as high if $n \geq 160$ larvae.

Notes: Because *Z. canadensis* larvae tend to occur in aggregations, the authors caution that trees should be selected for sampling at random throughout the plantation to avoid biasing the counts and misclassifying the infestation. This sampling plan was developed for use in white spruce plantations in northern New Brunswick and Québec. The authors do not recommend its use in natural stands or plantations outside of these regions without further testing.

Reference:

* Turgeon, J. J.; Régnière, J. 1987. Development of sampling techniques for the spruce budmoth, *Zeiraphera canadensis* (Lepidoptera: Tortricidae). Canadian Entomologist 119: 239-249.

Table

Table 1. Sequential sampling plan with two critical levels for the spruce bud moth in white spruce plantations

No. samples examined		Cumulative no. larvae found (n)[a]			
		Lower critical zone		Upper critical zone	
5		2–18		20–60	
6	L	3–21	M	27–69	H
7		4–24		33–79	
8	O	6–26	O	39–89	I
9		7–29		46–98	
10	W	9–31	D	52–108	G
11		10–34		59–117	
12		11–37	E	66–126	H
13		13–39		72–136	
14		14–42	R	79–145	
15		16–44		86–154	
16		18–46	A	93–163	
17		19–49		101–172	
18		21–51	T	107–181	
19		22–54		114–190[b]	
20		24–56	E	Terminal decision:	
21		25–59		if n <160, moderate;	
22		27–61		if n ≥160, high.	
23		29–63			
24		30–66			
25		32–68			
26		34–70			
27		35–73			
28		37–75			
29		39–77			
30		40–80			
31		42–82			
32		44–84			
33		45–87			
34		47–89			
35		49–91			
36		50–94			
37		52–96			
38		54–98			
39		55–101			
40		57–103			
41		59–105			
42		61–107			
43		62–110			

44	64–112
45	66–114
46	67–117
47	69–119
48	71–121
49	73–123
50	Terminal decision: if n <100, low; if n ≥100, moderate

[a]Sampling is pursued until the cumulative number of larvae exits the indicated inclusive ranges, or until maximum sample size is reached.