Pine Leaf Adelgid
Pineus pinifolia (Fitch)
Homoptera: Adelgidae

Dimond, J. B. 1974. Sequential surveys for the pine leaf chermid, *Pineus pinifoliae*. Tech. Bull. 68. Orono, ME: *University of Maine, Agricultural Experiment Station*; 15 p.

Objective: To develop field procedures for the classification of white pine damage produced by *P. pinifoliae*, and to relate infestation levels to tree damage.

Abstract: The range of the pine leaf adelgid, *Pineus pinifoliae* (Fitch), coincides with that of red, *Picea rubens* Sarg., and black, *P. mariana* (Mill.), spruce, its primary hosts, wherever they grow in proximity to eastern white pine, *Pinus strobus* L., its alternate host. Infestations on spruce result in terminal, compact galls that have the appearance of true cones consisting of many chambers each containing a single adelgid. Populations on white pine cause growth reduction and tree mortality in cases of extreme infestation.

A sequential survey procedure was described for determining infestation levels of *P. pinifoliae* as well as for classifying damage to white pine. Damage classes are based on the degree of needle stunting and needle color. Sampling of white pine was conducted until late-June. Galls on red and black spruce were sampled beginning around mid-May when galls can be differentiated easily from uninfested buds.

Sampling Procedure: Table 1 shows the degree of damage caused by *P. pinifoliae* at several life stages and population densities. There is one method to estimate *P. pinifoliae* damage and two methods to estimate population levels.

Estimating damage:

> Needle length: Remove one branch from the mid-crown of 20 white pine trees, and remove a twig from the mid-portion of the branch. Remove 10 current-year fascicles from the mid-portion of the twig and record needle length. Record the reduction in needle length for all fascicles less than 70 mm in length (i.e., if fascicle is 58 mm, then record 12). Add the total length of needle reductions for all 20 fascicles, reference the sequential sampling plan (Table 2) for a two twig sample, and continue sampling until a decision is met. Damage will be classified as either tolerable, critical, or intolerable based on the cumulative stunting of needles (Table 2).   Sampling should be conducted when needle elongation is complete (i.e., end of September in this study).

Estimating population levels:

Sampling the gallicola migrans stage: Sample this stage on white pine during June, or after the gallicolae have settled. Collect twigs as above, sampling one year old internodes, and counting and recording them as infested or uninfested. Continue sampling twigs from the same branch until 100 fascicles have been counted and then calculate the percentage of fascicles infested by *P. pinifoliae*. Reference the sequential sampling plan (Table 3) and continue sampling until a decision is met. Populations will be classified as either tolerable, critical, or intolerable based on the cumulative percentage of infested fascicles (Table 3).

Sampling for galls on red and black spruce in mixed stands: Sample around mid-May when galls can be differentiated easily from uninfested buds. Red and black spruce should be sampled in proportion to their relative abundance in the stand. Remove one branch from the second crown quarter from the top of the tree. Count and record the number of galls. Reference the sequential sampling plan (Tables 4), and continue sampling until a decision is met. Damage will be classified as either tolerable, critical, or intolerable based on the cumulative number of galls per branch (Tables 4).

Notes: A working knowledge of the complex biology of *P. pinifoliae* is required to successfully implement these sampling methods (Balch and Underwood 1950). Make sure not to sample edge trees where within-tree distribution of *P. pinifoliae* may not be uniform as in the infested stand.

References:

Balch, R. E.; Underwood, G. R. 1950. The life history of *Pineus pinifoliae* (Fitch) (Homoptera: Adelgidae) and its effect on white pine. *Canadian Entomologist* 82: 117-123.

Tables:

Table 1. Classification of degrees of damage produced by the pine leaf chermid on white pine and population levels of several life stages that produce those degrees of freedom.

Damage category	Damage description	No. of neosistens per cm of shoot	No. of gallicolae/10 fascicles on pine shoots	% fascicles infested by gallicolae	Galls per branch; stands mostly pine	Galls per branch; stands mostly spruce
Tolerable	Needles normal length, >70 mm, or slightly stunted, up to 5 mm	<5	<0.06	<5.5	<5	<1
Critical	Needles moderately stunted, 15-25 mm; (needle length45-55 mm), some shoots chlorotic or dead	12-38	1.7-5.5	10.4-30.1	13-20	3-7
Intolerable	Needles heavily stunted, >35 mm; (needle length <35mm), many shoots chlorotic or dead.	>165	>25	>65	>28	>10

Table 2. Sequential table for classifying pine leaf chermid damage on white pine, using needle stunting as the criterion. Calculated at 90% confidence level, using equations for a normal distribution.

No. of twigs examined (n)	Tolerable-d_1		Critical-d_2	Critical-d_3		Intolerable-d_4
	Cumulative stunting (<70 mm) in mm					
1	---		---	---		43
2	7		33	47		73
3	17	C	43	77	C	103
4	27	O	53	107	O	133
5	37	N	63	137	N	163
6	47	T	73	167	T	193
7	57	I	83	197	I	223
8	67	N	93	227	N	253
9	77	U	103	257	U	283
10	87	E	113	287	E	313
11	97		123	317		343
12	107	S	133	347	S	373
13	117	A	143	377	A	403
14	127	M	153	407	M	433
15	137	P	163	437	P	463
16	147	L	173	467	L	493
17	157	I	183	497	I	523
18	167	N	193	527	N	553
19	177	G	203	557	G	583
20	183		213	587		613
	$d_1 = 10n-13.18$		$d_2 = 10n+13.18$	$d_3 = 30n-13.18$		$d_4 = 30n+13.18$

Table 3. Sequential table for classifying damage potential of the gallicolae migrans stage of the pine leaf chermid on pine. Calculated at 90% confidence level, using equations for a binomial distribution.

No. of twigs examined (n)	Cumulative % infested fascicles					
	Tolerable-d_1		Critical-d_2	Critical-d_3		Intolerable-d_4
1	---		---	---		---
2	---		---	---		---
3	---	C	---	---	C	249
4	7	O	52	52	O	292
5	15	N	59	95	N	335
6	22	T	66	138	T	378
7	30	I	74	181	I	421
8	37	N	81	224	N	464
9	44	U	89	267	U	507
10	52	E	96	310	E	550
11	59		103	353		593
12	66	S	111	396	S	636
13	74	A	118	439	A	679
14	81	M	126	482	M	722
15	89	P	133	525	P	765
16	86	L	140	568	L	808
17	104	I	148	611	I	851
18	111	N	155	654	N	894
19	118	G	163	697	G	937
20	126		170	740		980
	$d_1 =$ 7.39n-22.06		$d_2 =$ 7.39n+22.06	$d_3 =$ 43n-119.9		$d_4 =$ 43n+119.9

Table 4. Sequential table for classifying damage potential of galls produced by the pine leaf chermid on spruce, where pine is a greater component of the stand than spruce. Calculated at 90% confidence level for tolerable vs. critical and at 70% level for critical vs. intolerable, using equations for a negative binomial distribution. Common $k=0.901$.

No. of twigs examined (n)	Cumulative number of galls per branch					
	Tolerable-d_1		Critical-d_2	Critical-d_3		Intolerable-d_4
1	---		---	---		95
2	---		---	---		119
3	1		---	---		144
4	9	C	---	---	C	168
5	17	O	---	---	O	193
6	25	N	69	75	N	217
7	32	T	77	100	T	241
8	40	I	85	124	I	265
9	48	N	93	148	N	290
10	56	U	100	173	U	314
11	64	E	108	197	E	339
12	71		116	221		363
13	79	S	124	246	S	387
14	87	A	131	270	A	412
15	95	M	139	294	M	436
20[a]	134	P	178	416	P	558
25	173	L	217	538	L	680
30	212	I	256	660	I	801
35	251	N	295	782	N	923
40	290	G	335	903	G	1045
45	329		374	1025		1167
50	368		413	1147		1289
	$d_1 = 7.81n-22.21$		$d_2 = 7.81n+22.21$	$d_3 = 24.3n-70.8$		$d_4 = 24.3n+70.8$

[a]Missing values between 21 and 49 can be calculated using equations at bottom of columns.

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