Multiple Seed and Cone Insects

Kozak, A. 1964. Sequential sampling for improving cone collection and studying damage by cone and seed insects in Douglas fir. Forestry Chronicle 40: 210-218.

Objectives: To develop a sequential sampling plan for cone and seed insects on individual Douglas-fir trees; to develop a sequential sampling plan for determining the percentage of Douglas-fir cones with adequate filled seeds for collection.

Abstract: Seed- and cone-feeding insects of Douglas-fir [*Pseudotsuga menziesii* (Mirb.) Franco] can cause substantial seed loss in seed orchards. Common pests include Douglas-fir cone pyralid (*Dioryctria abietella* Denis & Schiffermüller), Douglas-fir seed chalcid [*Megastigmus spermotrophus* (Wachtl)], Douglas-fir cone gall midge (*Contarinia oregonensis* Foote) and Douglas-fir cone moth [*Barbara colfaxiana* (Kearfott)]. These insects were monitored on Douglas-fir cones in a study conducted in British Columbia and a sequential sampling plan was developed for these pests on individual trees. Testing of this plan showed that an individual tree could be classified in terms of filled seed as poor, medium, or good within 30 minutes and usually by sampling <50 cones. The sampling plan is based on the collective damage produced by seed- and cone-feeding insects and does not require the identification of which species produced the damage, making it very useful to land managers without specialized training in entomology.

This technique is recommended for lightly to moderately infested trees.

Sampling Procedure:

To sample damaged cones from individual Douglas-fir trees: Randomly select trees for sampling in mid-August or when damage produced by common species of cone- and seed-feeding insects is visible to the naked eye. Randomly select cones throughout the canopy of selected trees if at all possible. Slice each cone in half longitudinally (Winjum and Johnson 1960) and count the number of filled and empty seeds found on one cut surface (one half of the cone). Refer to Table II to determine how many cones should be sampled based on the undamaged filled seed found on the cut surface of each cone. Continue sampling until the tree can be classified as poor, medium, or good.

The relationship between the number of undamaged filled seed on the cut surface of a cone (X) and the number of undamaged filled seed per cone (Y) can be expressed using the formula $Y = 3.04X - 0.33$ (Kozak et al. 1963).

To sample damaged cones from a stand of Douglas-fir (not from individual trees): Randomly select trees for sampling in mid-August or when damage produced by common species cone- and seed-feeding insects is visible to the naked eye. Randomly select four cones from a maximum of 50 trees. Slice each cone in half longitudinally and count the number of filled and empty seeds found on one cut surface (one half of

the cone). In general, cones with at least four filled seeds on the cut surface of one half of the cone are considered satisfactory for economical seed extraction. Using the formula Y = 3.04X – 0.33 as described above, 35.2 L of cones (approximately 1,000 cones) should produce at least 11,830 seeds if at least 4 filled seeds are found on the cut surface of each cone. Land managers can use this crude estimate to judge whether a stand should be harvested for seed or not.

Notes: This sampling plan does not require differentiation among the insect species damaging seeds and cones. However, see the original publication for sequential graphs for sampling Douglas-fir cone gall midge and Douglas-fir seed chalcid separately.

The original article also contains a procedure for determining the number of cones that should be sampled in order to classify a stand as having sufficient cone quality to justify seed extraction. Sampling heavily infested stands using this procedure may not be economical as, on average, more than 100 trees should be sampled before the classification can be made due to inter-tree variation. The effort required to classify a stand makes it unattractive for operational use and was not considered practical by the authors, thus it is not presented in this summary.

References:

Kozak, A.; Sziklai, O.; Griffith, B. G.; Smith, J. H. G. 1963. Variation in cone and seed yield from young open-grown Douglas firs on the U.B.C. Research Forest. Res. Paper 57. Vancouver, BC: University of British Columbia, Faculty of Forestry; 8 p.

Winjum, J. K.; Johnson, N. E. 1960. A modified knife cone cutter for Douglas fir seed studies. Journal of Forestry 58: 487-488.

Table

Table 2. Sequential table for sampling undamaged filled seeds.

No. of Cones Examined	Cumulative Number of Undamaged Filled Seeds			
	Poor vs. Medium		Medium vs. Good	
	Upper Limit of Poor	Lower Limit of Medium	Upper Limit of Medium	Lower Limit of Good
1	—	—	—	32
2	—	—	—	38
3	—	—	—	43
4	1	—	—	49
5	4	—	—	54
6	6	—	—	60
7	9	—	—	65
8	11	—	—	71
9	14	—	—	76
10	16	—	—	82
11	19	—	—	87
12	21	—	—	93
13	23	—	—	98
14	26	—	—	104
15	28	—	—	109
16	31	—	—	115
17	33	—	—	120
18	36	—	—	126
19	38	—	—	131
20	41	—	—	137
21	43	—	—	142
22	45	—	—	148
23	48	65	99	153
24	50	67	105	159
25	53	70	110	164
26	55	72	115	170
27	58	75	121	175
28	60	77	126	180
29	63	80	132	186
30	65	82	137	191

CONTINUE SAMPLING

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