Research Note

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A PROCEDURE FOR FORECASTING WESTERN LARCH SEED CROPS

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ABSTRACT

Successful regeneration depends upon good coordination between seed production and seedbed preparation. To aid forest managers in scheduling seedbed preparation, a simple sequential sampling plan for estimating potential cone crops as much as a year in advance of the seed fall was developed and is described herein. With advance knowledge of the cone crop prospects, the manager can schedule seedbed preparation or select an alternative action such as postponing work or substituting planting.

The potential of a western larch seed crop can be estimated as much as a year in advance of seed fall by sampling ovulate buds. When the winter buds are set at the end of the growing season, the staminate, ovulate, and vegetative buds are fully differentiated and recognizable. Ovulate buds then may be identified by their shape and size, a fact that provides a practical basis for estimating the possibility of a forthcoming seed crop.

Seed crop potential may also be evaluated in early spring by counting the new strobili or conelets with the aid of binoculars. The spring strobili are counted much later than ovulate buds. Consequently, the time before seed ripening and dissemination is much shorter than it is when bud counts are taken.

The forest manager who depends upon natural regeneration to restock cutover areas can coordinate seedbed preparation with seed production more effectively if he has some early knowledge of the prospective seed crop. If prospects of seed production are very poor he may decide to use artificial regeneration; if seed prospects are good, he may prepare as much seedbed as possible. To aid the forest manager in making this decision, a simple procedure to determine the prospects of the seed crop has been devised.

SAMPLING PROCEDURE

SAMPLING OVULATE BUDS

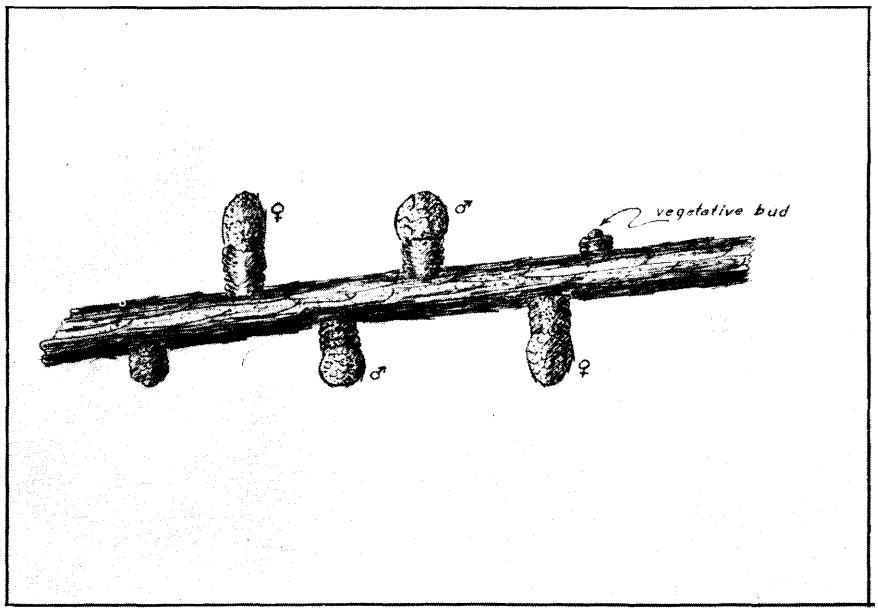
Bud description.--Western larch buds commonly are borne on the end of dwarfed, short, spurlike lateral branchlets. The vegetative buds are small--usually between 1/10- to 1/8-inch diameter. Flower buds, from 1/8- to 3/16-inch diameter, are as long or longer than wide. The staminate buds are usually globose or subglobose, about as long as they are wide, and ovulate buds are usually longer ($1\frac{1}{2}$ to 2 times) than their width and are either rounded or conical on the end (figs. 1A, 1B). The ovulate buds can be identified with ease, thereby making sampling simple. When the buds cannot be identified visually, they can be cut to expose a longitudinal section and positively be identified (fig. 2).

Collecting the sample.--Seed trees are sampled by randomly collecting a minimum of four and up to 12 major branches in the larch crown. Select only dominant or codominant full-crowned trees growing in forest stands--not open grown. Do not include internodal branches. A major branch is defined as one that originates at a node and is free to grow to the full average crown width where it is located in the crown. Collect branches preferably in the upper two-thirds of the crown. Obtain sample branches by (1) climbing the trees, (2) examining trees felled in logging, or (3) shooting them off with a rifle. Count the number of ovulate buds for each branch.

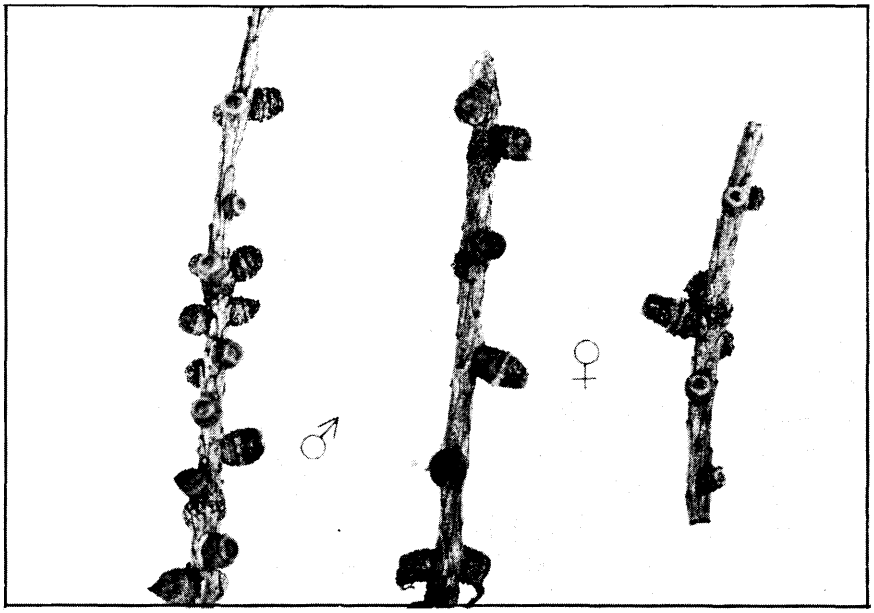
SAMPLING STROBILI WITH THE AID OF BINOCULARS

Conelet description.--The strobili (new conelets) appear after the tree has begun growth in the spring--usually about April 15 to May 15. They precede the foliage by several days. The color of the strobili varies from green and green-brown to a distinctive red color. Strobili grow very rapidly and soon reach the size of the old cones that have adhered from previous years. The old cones are distinguishable from the new strobili by color because size distinction is not reliable.

Counting conelet samples.--The sampling procedure is much the same as that for counting buds. The observer, using binoculars, randomly selects a minimum of four major branches. He scans each one and counts the strobili, avoiding counting persistent cones from the previous years. Because size is not reliable in separating the new conelets and old cones, the observer should move about until the light reflects the color of the conelet to him. Strobili are most easily seen from the ground with the aid of 6X or 7X binoculars. After the foliage grows out, the presence of the strobili is obscured.



A



B

Figure 1.--A, Sketch of typical winter buds of western larch showing ovulate, staminate, and vegetative buds. B, The twig on the left shows only staminate and vegetative buds, while the other two twigs illustrate all types of buds.

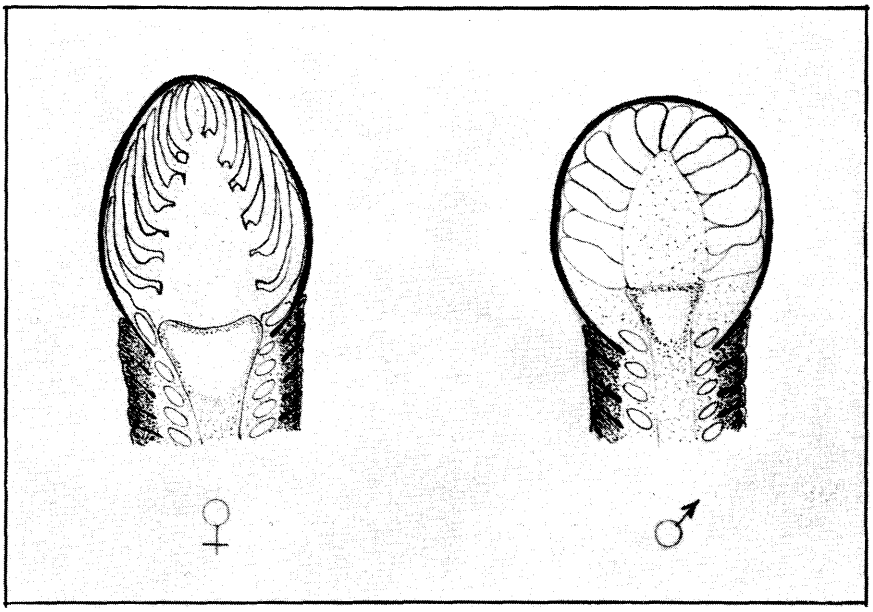


Figure 2.--The longitudinal section of ovulate and staminate buds.

CLASSIFYING PROSPECTIVE CONE PRODUCTION

To determine relative production, the counts of ovulate buds or strobili per major branch must be related to some standard. Therefore, a sequential sampling plan[1] was evolved using the counts of strobili obtained during the good seed year of 1954. This plan furnishes an objective technique for rating and forecasting prospects of the developing seed crops.

The coefficient of variation was determined for the sample trees in each sample counted in 1954. A curve was fitted to the relationship of the coefficient of variation and the mean number of strobili per branch. This curve provided estimates of the coefficient of variation for both low and high cone production from which the estimated standard deviations used in the sampling plan were obtained. For the sampling plan, 10 strobili per branch were chosen arbitrarily as the lower limit of a good seed crop, and three strobili per branch were designated as the lower limit for a medium crop. The probability of making a wrong decision based upon the sampling was set at 10 percent in the plan. Values computed for the sequential sampling plan are shown in figure 3, a suggested tally form.

To use the sequential sampling plan, estimate seed production for individual trees as follows: Record the branch counts (ovulate buds or strobili) in column 2 of the tally form as they are collected. Adjust the count for anticipated loss by reducing the count 50 percent and add the adjusted value to the cumulative total (Σx) column 4 or 7. At each entry compare the cumulative total against the critical values on either side of columns 4 and 7.

[1] For a discussion of computing sequential analysis charts, etc., see chap. 18, pp. 304-317, Dixon and Massey, "Introduction to Statistical Analysis," 2d ed. New York: McGraw-Hill Book Company. 1957.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Branch no.	Branch tally (x)	Good	vs. Σx	Medium	Medium	vs. Σx	Poor
1	8	20				4	
2	4	29				6	
3	8	38				10	2
4	7	47		25	26	13.5	6
5	0	56		34	30	13.5	10
6	2	65		43	34	14.5	14
7	6	74		52	38	17.5	18
8		83		67	42		22
9		92		70	46		26
10		101		79	50		30
11		110		88	54		34
12		119		97	58		38

Figure 3.--A suggested tally form for sequential sampling of prospective western larch seed crops in western larch trees.

After each comparison decide whether the crop can be classified or sampling should be continued. If the cumulative total exceeds the column 3 value on that line, sampling stops and the crop in prospect is rated as good; if the total falls below column 5 and above column 6 values, sampling also stops and the prospective crop is rated medium; finally, if the cumulative total falls below column 8 values, cease sampling and rate the prospective crop as poor. If none of the above conditions are met, continue to sample by counting another branch sample and adding it to the tally. If no decision has been reached after 12 sample counts have been accumulated, stop sampling and classify the prospective crop in the nearest category approached by the cumulative count.

The crop of the tree used as an example in the tally sheet in figure 3 was rated as poor after the counts from seven branches were tallied. The total 17.5, attained after the seventh branch count was accumulated, fell below the critical value 18 in column 8, line 7. In some instances a decision may be made after one or two branches have been sampled, but a minimum sample of four branches per tree selected, one from each quarter of the tree crown length, is recommended.

Tree no.	Tree tally (x)	Good	vs. Σx	Medium	Medium	vs. Σx	Poor
1	7	12	7	6	6		2
2	8	21	15	15	11		6
3	10	30	25	24	14		10
4	8	39	33	33	18		14
5	43	48	76	42	22		18
6		57		51	26		22
7		66		60	30		26
8		75		69	34		30
9		84		78	38		34
10		93		87	42		38
11		102		96	46		42
12		111		105	50		44

Figure 4.--A suggested tally form for sequential sampling of prospective seed crops in western larch stands.

Using the same procedure, the seed crop from a stand can also be estimated. The estimated average buds or cones per branch on each tree classified in the stand are entered on the form shown in figure 4. The limits on this form apply to the means of sample trees. Thus the mean number of cones per branch of each tree as it is determined by sampling within the tree crown is recorded on the form illustrated in figure 4. The stand classification--good, medium, or poor--is determined in the same manner for stands as for individual trees.

DISCUSSION

The sampling basis for estimating standard deviation used in computing the critical values in this study is small. Because additional data are highly desirable, samples should be collected each year. As additional data are accumulated, better estimates of the standard deviation and other characteristics can be made. It is important to span the years as well as areas, so there is no advantage in trying to collect a large sample in any one year.

The technique described above provides only an estimate of the prospective seed crop. A large sample of buds or early strobili does not necessarily mean that a large seed crop will materialize. Unseasonable frost or seed and cone insects are among the many agents that may cause seed loss between flower initiation and cone maturity and, thereby, reduce or eliminate the seed crop. Further studies are required to increase our understanding and knowledge of these factors. A better basis for forecasting seed years will then be provided.

This technique should aid forest managers in collecting data on seed year prospects as a basis for planning seedbed preparation. Although the possibility of crop failure from unpredictable factors may be considerable in cases of good and medium prospects, there should be a high degree of success in forecasting poor or fail crops. When seedbed preparation is carried out in the face of very poor or fail seed crops, the probabilities of regeneration failure are high. Knowing the prospect of poor or fail seed crops several months before seed fall, the manager can alter plans by postponing the work or substituting planting.

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