

Relationship of Filled Seed Set and Pounds of Cleaned Seed Yield per Bushel of Ponderosa Pine (*Pines ponderosa* Dougl. ex. Laws.) Cones in the Southwest

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A cone and seed study of ponderosa pine (Pines ponderosa Dougl. ex Laws. and P. ponderosa var. scopulorum) showed good correlations between filled seed set counts, filled seeds per cone, and pounds of seed yield per bushel of cones. In this study, the term filled seed set refers to half the number of gametophyte-filled cut seeds exposed on both faces of a cone that has been cut along its longitudinal axis. (Tree Planters' Notes 37(1):3-4; 1986)

An average of 12,360 acres have been planted each year on national forest lands in Arizona and New Mexico from 1980 through 1984. Almost 86 percent of these acres were planted with ponderosa pine. It is therefore important to provide the best available information to cone collection planners for estimating seed yields of cone crops for this species. The most useful information is expressed in pounds of clean seed yield per bushel of cones. Such information has been limited to a range and/or average of data reported in USDA Agriculture Handbook No. 450 (2). No previous work has been done to correlate an average filled seed-set count to clean seed yield per bushel of cones collected from this species. Olson and Silen (1) made a correlation of Douglas-fir filled seeds per cone to filled seed sets and provided data to estimate clean seed yield per bushel of cones.

Methods

Closed cones from the 1983 fall collections were cut lengthwise to expose cut seeds on each face (fig. 1). Filled cut seeds were counted on both faces and divided by 2 to determine an average seed-set count for one face. Both halves of each cone were put into a paper lunch sack. Each sack was labeled with the associated filled seed-set count. After the cones dried and opened in the sacks, seeds were extracted by peeling each scale from the fertile part of the cone axis. Dewinging was done by hand rubbing. Filled cut seeds were discarded as prerecorded data. Unfilled cut seeds were recorded. Uncut seeds were placed on a solid foundation and cracked with a small hammer. Cracked seeds

were examined and recorded as filled or unfilled.

Cone lot shipments were checked at the Albuquerque Tree Nursery to verify that the number of bushels shipped agreed with Forest Service records. Twenty closed cones from each lot were cut, and filled seed sets were counted, averaged, and recorded. Normal cone drying, seed extraction, and cleaning procedures were then followed. After seed lots were dried for storage, they were weighed, counted, and recorded.

A linear regression analysis was done first to determine the relationship of filled seed-set counts to filled seeds per cone. This information was used in the following formula to estimate the number of cones in a bushel:

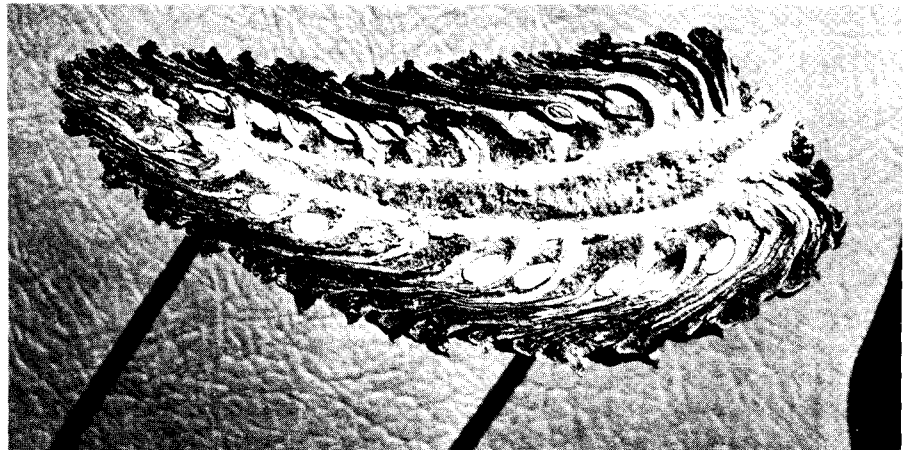


Figure 1—Cut face of a ponderosa pine cone that had an average of 10 cut-filled seeds exposed on both faces, for a filled seed-set count of 10.

where:

$$C = 1/Y \times V \times N$$

C = cones per bushel,
1/Y = the reciprocal of filled seeds per cone for an average filled seed-set value entered on the calculated linear regression line,
V = pounds of clean seed extracted per bushel of cones, and
N = number of clean seeds per pound.

If any estimate was less than 100 cones, or exceeded a calculated average of 255 cones per bushel by 100 cones, the nursery data were presumed to be seriously flawed by a filled seed-set sample error. An error of this nature would occur if by chance the sample was not a true representation of the cone lot. "Flawed" data were not used to calculate the linear regression line for pounds of cleaned seed yield per bushel of cones.

Results

Raw data from this study may be obtained by writing to the author of this paper. Filled seed-set counts and filled seeds per cone are strongly related ($r = 0.88$) (fig. 2). The relationship between filled seed-set counts to pounds of clean seed yield per bushel of cones is weaker ($r = 0.63$).

Of the 68 southwestern ponderosa pine seed lots processed at the nursery, only 8 were considered to

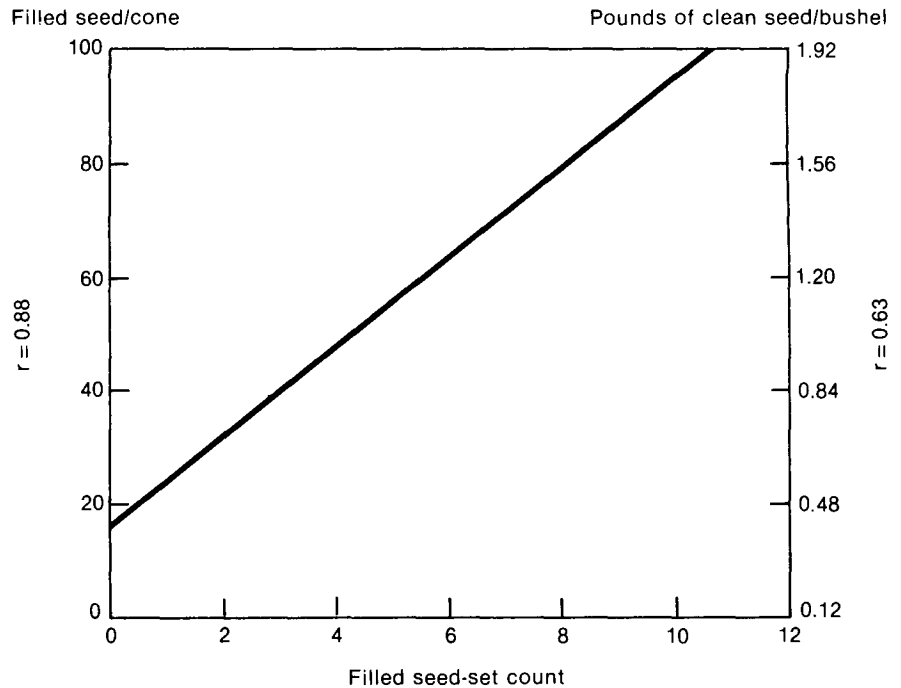


Figure 2—Relationship of filled seed-set counts to filled seeds per cone ($Y = 16.987 + 7.668X$) and pounds of clean seed per bushel ($Y = 0.433 + 0.137X$) ponderosa pine.

be seriously flawed by filled seed-set sample errors. These lots showed an estimated low of 98 cones per bushel and a high of 524 cones per bushel. Eliminating these data improved the correlation by 44 percent.

Conclusions

Although the relationship between filled seed sets and pounds of clean seed yield per bushel of cones is weaker than expected, it is reliable for use and more valid than using a range or average of data from geographically different sources. Obtaining filled seed-set

counts from on-going cone collection activities and applying the average to the results of this study would detect local yield variations. Cone collectors could then adjust operations accordingly.

Literature Cited

1. Olson, Donald L.; Silen, Roy R. Influence of date of cone collection on Douglas-fir seed processing and germination: a case history. Res. Pap. PNW-190. Corvallis, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1975; 10 p.
2. Schopmeyer, C. S. (tech. coord.). Seeds of woody plants in the United States. Agric. Handbk. 450. Washington, DC: U.S. Department of Agriculture; 1974; 883 p.