

Early Verification of a Hybrid Between Noble and California Red Firs

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Abstract. Hybrids between *Abies procera* Rehd., and *Abies magnifica* A. Murr., made reciprocally at Marys Peak near Corvallis, Oreg., and near Placerville, Calif., suggest that no significant genetic barriers prevent crossing of the two species where ranges overlap. Hence, maintenance of species differences must be looked for in other factors. Cotyledon number, a very early expressed trait, was used to verify that recently germinated seedlings were true hybrids. *A. magnifica* cotyledons averaged nine, *A. procera* five, and the hybrids at both locations seven, with each seedling population statistically distinct.

This study provides preliminary data on successful crosses in both directions between noble fir (*Abies procera* Rehd.) from the Oregon Coast Ranges and California red fir (*A. magnifica* A. Murr.) from the Sierra Nevada of California. It also illustrates the successful use of cotyledon number for very early verification of a hybrid.

In 1962, fresh pollen lots were exchanged between the Pacific Northwest and Pacific Southwest Forest and Range Experiment Stations, and each Station used this pollen on trees local to their field stations. Noble fir pollen, collected in Oregon in 1961 and deep-frozen for a year, was also used in the California crosses (California red fir $\times$ noble). In Oregon, the crosses were made on Marys Peak at 3,900-foot elevation west of Corvallis, Oreg., with pollen from near Placerville and Lake Tahoe in California. The California crosses (California red fir $\times$ noble) were made at High Meadows, about 5 miles southeast of Lake Tahoe at 7,800 feet.

In Oregon, some sound seed of the noble $\times$ California red fir cross was produced from five of the six noble fir trees; the sixth tree produced only a few seed even when local pollen was used. Putative hybrid seedlings have been grown from seed of all five trees. Comparison between sound seed produced with local noble fir pollen and that with red fir provides a measure of the barrier to natural crossing, if pollen of equal vigor is used for both species. Only two of the five noble firs produced enough cones to make sound seed comparisons. On a single tree, red fir pollen set 26 seeds per cone, whereas on the same tree noble fir pollen from 3 different trees produced 63, 176, and 190 seeds per cone. On the second tree 4 lots

of red fir pollen set 28, 25, 17, and 12 seeds per cone compared with 85, 46, 45, and 32 for the noble fir pollen from 4 different trees. Since the red fir pollen was sent in two shipments from different trees and still set similar numbers of seed, the possibility that the test was confounded with pollen of low vigor was minimized. Thus, the cross apparently was readily made with noble fir as female parent, but seed set with red fir was reduced about two-thirds in this instance.

The three red firs used as female parents in California flowered a few days earlier than the Marys Peak noble firs, and most of the noble fir pollen lots that were used in California had been collected a year earlier and deep-frozen. These 1961 noble fir pollen collections were from Marys Peak and two localities in the Oregon and Washington Cascades. Age had little effect on the ability of the pollen to produce germinable seed, though the basis of comparison was limited. All 11 noble fir pollen lots yielded hybrids, from 9 to 96 germinable seed per cone. The single lot of red fir pollen used in the control crosses produced only 39 germinable seed per cone on the average, slightly less than the mean 45 seeds per cone of the noble fir pollen lots. Only one of the three red firs gave consistently reduced seed yields with noble fir compared with red fir pollen. Thus, the results of these crosses made on red fir provide little indication of any genetic barrier to the crossing of these two species.

The putative red $\times$ noble fir hybrids were grown at the Institute of Forest Genetics, Placerville, with red fir seedlings, and the noble $\times$ red fir hybrids at Corvallis with noble fir seedlings. When the seedlings were 3 and 6 months old, the hybrids were compared with the two parent species in height, needle number, cotyledon number, cotyledon length, needle

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groove, and needle tips. The only useful criterion for distinguishing the hybrids at this age proved to be cotyledon number. Franklin¹ has shown that in this trait the two species differ markedly. Noble fir normally has 4 to 7 cotyledons, whereas

¹ Franklin, Jerry F. A guide to seedling identification for 25 conifers of the Pacific Northwest. U.S. For. Serv. Pacif. Nthwest. For. Range Exp. Sta. 65 pp. 1961.

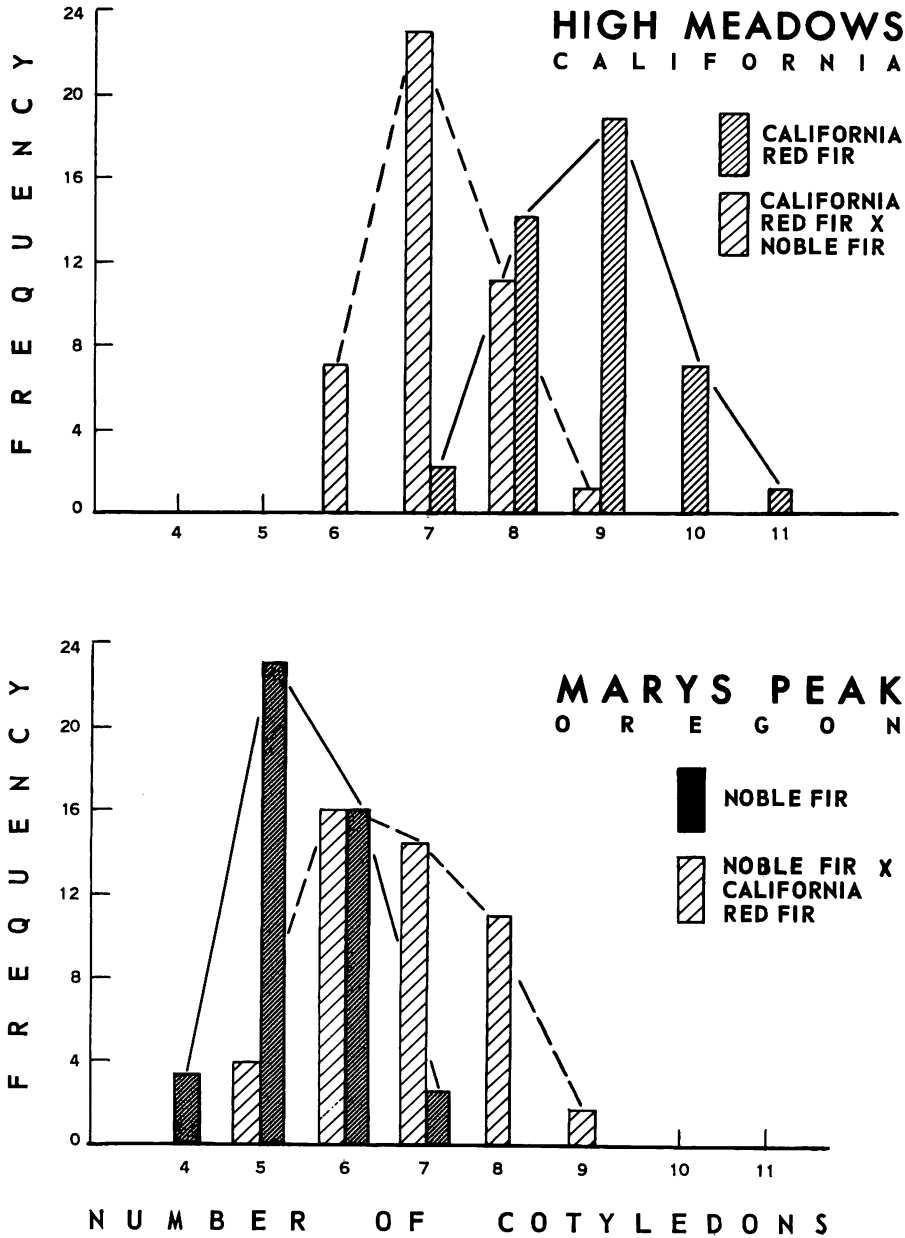


FIGURE 1. Frequency distribution of noble fir, California red fir, and their hybrids. The cotyledon number of the hybrid seedlings is significantly higher than the 4 to 7 cotyledons of noble fir and lower than the 7 to 11 cotyledons of red fir.

red fir has 6 to 13 (7 to 11 in our material). The histogram in Figure 1 is based upon the frequency distribution of cotyledon numbers of 168 seedlings, 42 from each group. It is apparent that both hybrid lots were intermediate to the parent species in average number of cotyledons. The noble fir seedlings averaged 5.4 cotyledons, the noble $\times$ red fir hybrids 6.8, the red $\times$ noble fir

hybrids 7.1, and the red firs 8.8. The small discrepancy between the two hybrid groups may be related to the fact that the same parent trees were not used in the two sets of crosses. A *t*-test was made in each case with highly significant differences in cotyledon numbers between hybrid and nonhybrid seedlings.
