



Station Note

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The Early Growth of *Larix occidentalis* x *L. leptolepis* hybrid

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Japanese larch (*Larix leptolepis*) was widely used in interspecies hybridization. Hybrids from natural or controlled pollination were made with *L. decidua*, *L. gmelini*, *L. g.* var. *japonica*, var. *olgensis*, var. *principisrupprechtii*, *L. occidentalis*, and *L. sibirica* (Dimpflmier, 1959, Fairbairn, 1959, Schoenike, 1961). All interspecies crosses made within the section *Pauciseriales* were successful, but the inter-section cross between *L. decidua* (Section *Pauciseriales*) and *L. occidentalis* (Section *Multiseriales*) produced only one triploid hybrid (Larsen and Westergaard, 1938).

The most well-known and extensively planted larch hybrid is the Dunkeld larch, a spontaneously produced *L. leptolepis* x *L. decidua* hybrid from Dunkeld, Scotland. It proved to be more vigorous than the progenitors in Europe and in North America (Cook 1942, Edwards 1956, Ostefeld and Larsen, 1930). The artificial F₁ hybrid of this cross was mass produced and planted in a commercial scale.

A hybrid between the western larch of North America (*L. occidentalis*) and Japanese larch reported here was obviously more vigorous at the early seedling stage, and was significantly higher in height growth than the open-pollinated progenies of western-larch seed parents at the end of the first and second growing seasons (Fig. 1). This interspecific hybridization was made in four years since 1966 in cooperation with Takanobu Furu-koshi of the Forest Genetics Research Institute, Meguro, Japan, and the late Dr. S. S. Pauley of the University of Minnesota in a larch hybridization experiment between *L. leptolepis*, *L. laricina*, and *L. occidentalis*. Reciprocal crosses were made with pollen of the mother parents by the cooperators. In both cases, the seed set and viability of the *L. occidentalis* x *L. leptolepis* hybrid seed were low. Result of four seasons' controlled pol-

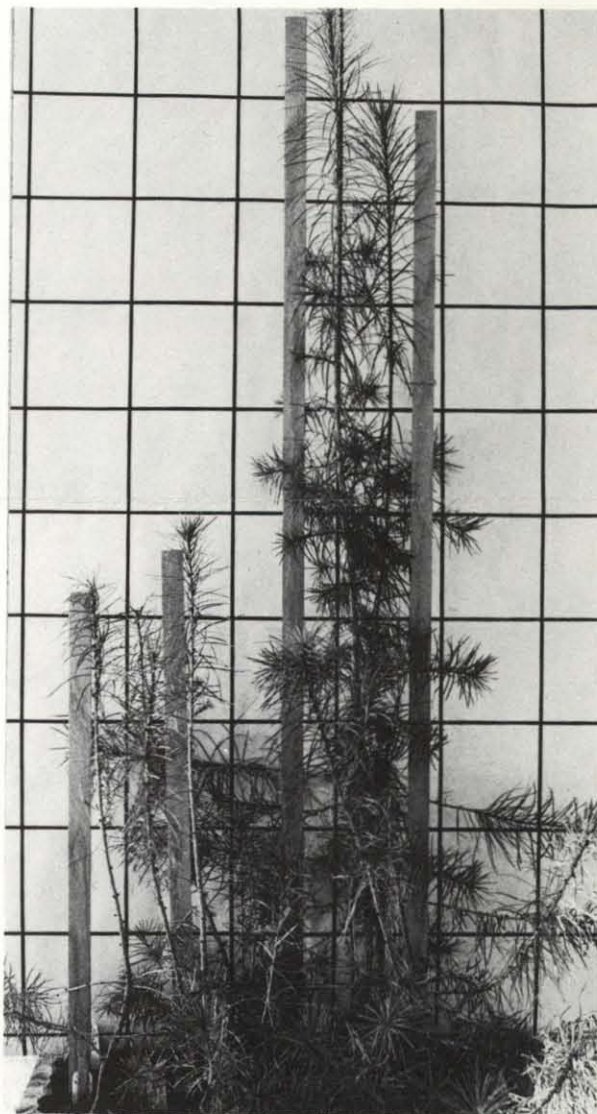


Figure 1. Two-year old seedlings of *Larix occidentalis* x *L. leptolepis* hybrid (right) and *L. occidentalis* (x 1/8).

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linations suggested possible incipient incompatibility in this inter-section hybridization.

POLLEN SOURCES

The *L. leptolepis* pollen used in the hybrids included in this report were collected from two trees from each of the following two natural stands, (1) Tenzintoge (Fuji Mt. 1400 m), and (2) Mizugoya (Fuji Mt. 1650 m). They are located on the northern slopes of the Fuji Mountain, and close to the lower natural altitudinal distribution for this species (Fig. 2). The low-altitude pollen sources were used for their early flowering. *L. occidentalis* in the vicinity of Moscow Mountain in northern Idaho was receptive for pollination at about mid-April, and *L. leptolepis* pollen trees in Japan bloomed in the early part of April. Female flowers were isolated about 10 days before pollination. Fresh forced pollen were used in the pollination with a syringe-type duster.

The western larch used as the female parents were random trees in natural stands of the Moscow Mountain area. They were trees of regular form with fully developed crowns located near forest clearings. They produced male and female flowers in abundance almost every year.

HYBRID SEEDLINGS

In the early seedling stage, the hybrid had longer cotyledons, and longer primary needles than the western larch and Japanese larch. The average primary needle length of the hybrid was 4.1 cm and those of *L. occidentalis* and *L. leptolepis* were 2.7 cm and 3.3 cm respectively. The needle stomata characters of the hybrid were intermediate between the two parents. The average number of stomata rows on the dorsal surface was 7.2 rows in the western larch, 12.5 in the Japanese larch, and 10.7 in the hybrid. On the ventral surface, the western larch had 1 to 4 rows of stomata, the hybrids and the Japanese larch had no stomata. In subsequent crops of hybrid the ventral surface predominately was free of stomata with the exception of a few needle samples which bore 1 to 2 rows of stomata on the ventral surface.

The hybrid also differed from the western larch in bud color and shape of needle tips. The hybrid broke dormancy earlier, had larger number of cotyledons, more cells in the endodermis, and less cells in the epithelial layer than *L. occidentalis*.

HEIGHT GROWTH

In the twelve hybrids raised from the first crop of controlled pollination, the most striking difference between the hybrids and the open-pollinated western larch was in height growth (Fig. 1). The hybrid seedlings and those from open-pollinated seeds of the mother trees were raised in 2 x 2-inch tubes arranged in randomized complete blocks with two replicates in a greenhouse under 24-hour day-length in the first year and under natural day-length in the second year. The 4-month, 1-year and 2-year height growth were tabulated (Table 1).

The differences in height growth between the hybrids and the open pollinated progenies of the four seed trees which produced hybrids were significant at 1% level for both the 4-month, 1-year and 2-year height growth. The height growth of the open pollinated western larch progenies of No. 2, No. 3, No. 4 and No. 5 trees were not significantly different. The hybrid samples were not large enough to determine conclusively the effect of different pollen sources. However, 1-year and 2-year growth periods showed that the Mizugoya (Fuji 1650 m) hybrids were consistently higher than the Tenzintoge (Fuji 1400 m) hybrids (Fig. 3). This difference suggested the importance of genetic variation of pollen sources in connection with the hybrid performance.

GENETIC VARIATION OF *L. leptolepis*.

L. leptolepis has a small natural range of distribution. Natural forests appear in scattered stands in central Honshu between 900 m and 2800 m in elevations (Fig. 2). Distinct genetic variation in growth and morphological characters were reported within this species. Hayashi (1951) observed that the best growth in the



Figure 2. Natural distribution of (1) *Larix occidentalis* (British Columbia, Idaho, Montana, Oregon, and Washington), (2) *L. leptolepis* (Honshu), and (3) *L. leptolepis* var. *louchanensis* (Lushan, Lower Yangtze Valley).

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Table 1: Height growth of *L. occidentalis* x *L. leptolepis* hybrids and the open pollinated progenies of *L. occidentalis* (in cm).

Seed trees (<i>L. occidentalis</i>)	4-months		1-year		2-year	
	Wind	Hybrid	Wind	Hybrid	Wind	Hybrid
Tree No. 1	7.8 (3*)	8.3 (2)	18.0 (2)	60.5 (2)	46.5 (2)	124.5 (2)
Tree No. 2	7.6 (15)	8.7 (7)	12.9 (12)	16.0 (7)	33.1 (12)	44.7 (7)
Tree No. 3	8.8 (21)	12.6 (1)	11.1 (14)	20.0 (1)	31.2 (15)	38.0 (1)
Tree No. 4	7.1 (24)	**	10.4 (12)	**	32.1 (12)	**
Tree No. 5	7.1 (22)	10.9 (2)	14.6 (14)	47.0 (2)	32.6 (14)	94.0 (2)

* number of seedlings measured
 ** no seeds germinated

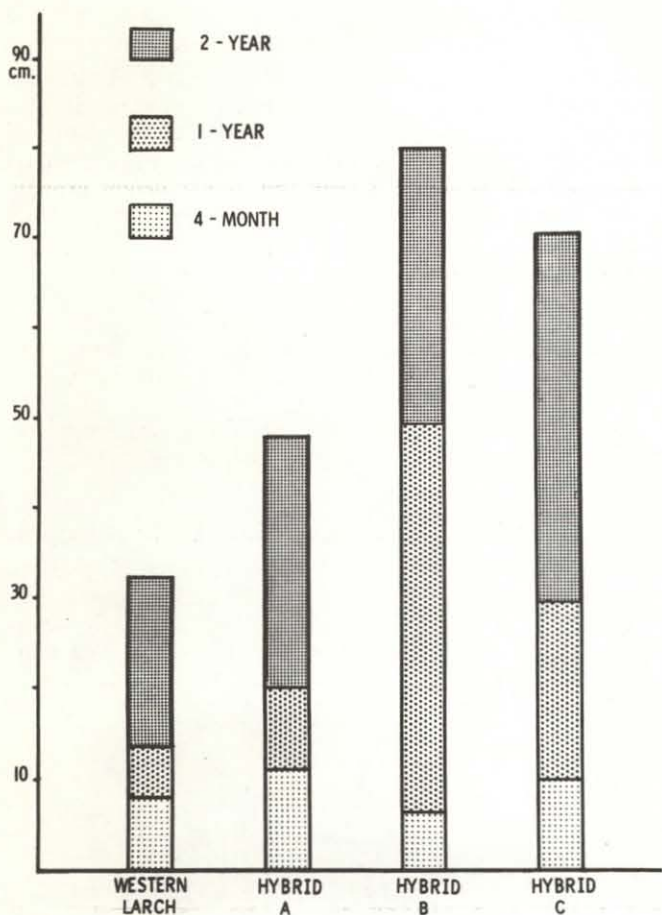


Figure 3. Height growth of western larch and hybrids of (A) Tenzintogi tree No. 1 (Fuji 1400 m) and (B, C) Mizugoya trees No. 1, No. 2 (Fuji 1650 m) pollen sources.

natural range was between 1500 m and 2300 m. The best height growth in eastern Iowa was from seed sources above 1850 m (Kepler 1962). In Minnesota (Pauley et al 1965) and in Wisconsin (Lester 1964) the best height growth was not associated with the altitude or latitude of the seed origin, but the best two seed sources were the same in both tests.

In experimental plantations of several species of larch in New York State *L. leptolepis* and its hybrid *L. leptolepis* x *L. decidua* consistently were superior in growth rate (Littlefield and Eliason 1956) and volume production (Eliason and Carlson 1963) to all other larch. *L. leptolepis* was superior to *L. decidua* in Minnesota (Pauley et al 1965). But in Idaho open pollinated seedlings of Fuji seed sources and its hybrid from the reciprocal cross (*L. leptolepis* x *L. occidentalis*) sustained light frost damage at the tender branch tips in early September. No frost damage was observed in the open pollinated progenies of the western larch mother trees included in the hybridization, nor in any seedlings in a 14-seed origin provenance test of western larch from Canada, Idaho, Montana, Oregon, and Washington.

Differences in frost hardiness of Japanese larch were reported in earlier provenance studies. Lindquist (1956) observed in a 14-seed origin experiment that there are several possible climatic races within the Japanese larch each adapted to various climatic conditions. The result of the 25-seed origin IUFRO international Japanese larch provenance test made in western Europe and North America had shown significant genetic differences in frost hardiness and cold resistance (Langner 1958, Hattemer 1970). The potential value of *L. leptolepis* will be its immunity to larch canker (*Dasyscypha Wilkommii*), its demonstrated superiority in growth rate, and its use as the parents of heterotic hybrids. The genetic variations in *L. leptolepis* as shown in provenance studies indicated that further improvement in growth and frost resistance of the hybrids maybe obtained through selection of breeding materials.

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