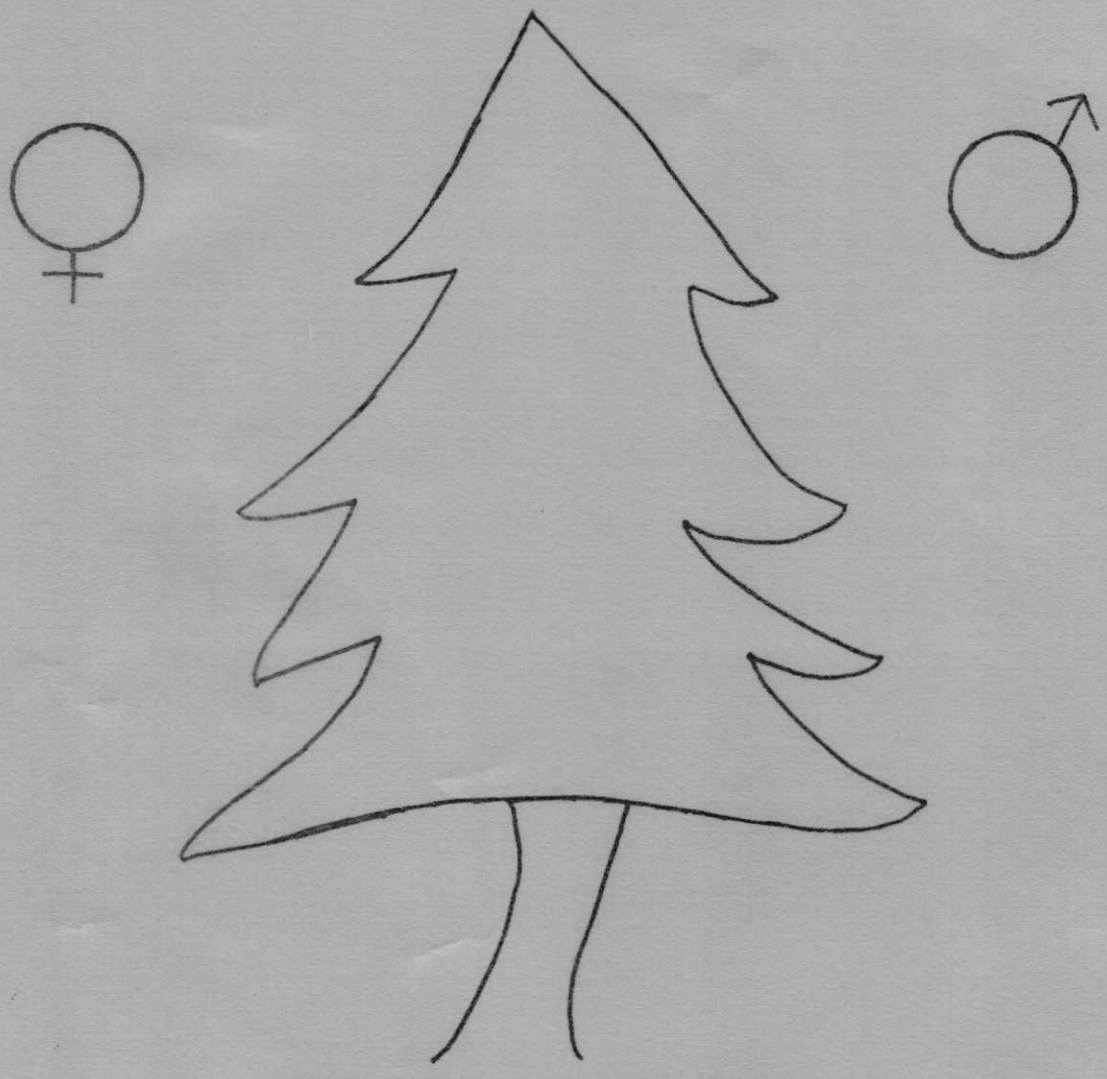
GROUP 1

U.S.F.S.
REGION 6



DORENA TREE
IMPROVEMENT CENTER
JULY, 1982

GROUP 1

STOP 1 - Seed Plant, Chuck Gansel

STOP 2 - Ribes Garden, Bob Weaver and Kim Mahlein

STOP 3 - Greenhouse

STOP 4 - Field 14, Jerry Berdeen and Stan Meso

STOP 5 - Rust Testing, Safiya Samman

STOP 6 - Nursery beds, Bill Sery

SEED PLANT

Construction Complete: June, 1980

Cost: $520,000

Size: 60' X 140', 8400 ft^2 of floor space

Main Function: Extract, process and store all tree improvement seed for Region 6

Heating: This building is equipped with a specially designed solar roof which utilizes the entire roof as a solar collector. The roof is essentially a large greenhouse. Visible and ultra-violet light are transmitted through Filon® panels, and are intercepted by a highly absorbative paint on a sheet metal surface immediately beneath the fiberglass panels. Heat then moves upward to a plenum in the peak of the building and is then sucked downward and distributed throughout the building by an elaborate ducting system. An electric hot-water boiler provides heat when the solar roof is not providing a sufficient amount.

Cone Storage Area: The north end of the seed plant provides inside storage for up to 5,000 lots in a semi-controlled environment. If we receive more lots, other storage facilities will have to be obtained. 75°F and 40% R.H. with good air circulation are the average condition maintained during cone storage.

Cone Flaring Room: Lots which do not flare in the large cone storage room can be re-soaked and taken into the cone flaring room. This room has a complete set of environmental controls; conditions can be created to flare even the most difficult lot. 85°F, 25% R.H. are usually maintained although other combinations are easily attainable.

Seed Processing Room: This room contains cone tumblers, seed clippers, Silen blowers, and hand-picking tables. Function of each piece of equipment will be explained by your guide. A vacuum system has been designed into this room to remove cone dust from processing. This dust can be a significant health and fire hazard. Cones are ground into dust in a hammermill and hauled away in a dump-bed pickup.

Seed Packaging Room: This room is divided into two smaller rooms. Both rooms have environmental controls. One room has shelves on which seed boxes are stored until seeds reach the desired 5-7% moisture content. The other room has all the seed packaging equipment. Seeds are weight-counted, placed in multi-walled bags, and sealed.

Laboratory: A variety of tasks are performed in this room. Quality control tests such as X-ray and moisture tests are run on lots that are processed in the seed plant. Spores are extracted and analyzed for the rust-screening program. The same is done for pollen in the tree breeding program. Procedures are being developed and refined for cone analysis which will provide information for seed yield predictions and extraction efficiency.

Seed Freezer: This freezer has the projected capacity of 25,000 lots with the existing shelving, but this capacity can be increased with addition of extra shelving. We are presently storing nearly 16,000 lots. Temperature is maintained at 0°F. Relative humidity presently fluctuates between 40 and 60 percent, but after we have a dehumidifier installed, we will maintain it at 25% R.H. These conditions combined with the new multi-walled packaging system will provide for a seed storage longevity of several years.

Bill Sery
July, 1982

RIBES GARDEN
DORENA TREE IMPROVEMENT CENTER

The Ribes garden was established to provide a dependable supply of blister rust inoculum for the resistance screening program.

The original planting consisted of two species of cultivated currants and three species that are native to the region. Cuttings from the native species were collected at various locations in the region and rooted at Dorena for transplanting to the garden. One of the cultivated varieties, R. nigrum proved to be exceptionally good for growth and production of inoculum. This species now occupies 1/3 of the garden area. The red current grew well but had low susceptability to rust infections and has been mostly eliminated.

The three native species originally planted were R. bracteosum , R. petiolure, and R. sanguineum. Other species have been tested but the original three are being propogated. R. sanguineum is a very low volume producer of infected leaves. It is retained in the garden because evidence indicates that one of the strains of rust fungus is specific to R. sangiuneum.

The garden is on heavy clay soils with a high water table. This has caused the Ribes root systems to grow horizantally just below the soil surface, where they are subject to repeated damage during cultivation and weed control operations. We are now installing raised beds, filled with the same growing media used in the nursery beds. This provides additional depth of rooting area in a soil mix containing all needed nutrients, and eliminates root damage from mechanical tilling between rows. It's expected that this will promote more vigorous growth and greater leaf production.

Hedging of R. nigrum, and plants of the other species with suitable growth potential, increases the number and vigor of new shoots and greatly enhances leaf production.

We are planting some previously unused parts of the garden. The cuttings for these new beds are being gathered throughout the region from a diverse base of plants, whose locations are recorded and identities maintained. By this method we will broaden the genetic base, include any local varients, and avoid duplication of previous collections.

The fertilizer maintenance program consists of an early spring application of Osmocote 13-13-13, a slow release compound which releases nutrients gradually through an eight to ten month period.

Irrigation is now done with a low volume drip system. We plan to change to a mist system because the mist helps spread and promote rust infection on the Ribes leaves, and because water from the drip system fails to wet all the soil mix in the raised beds, running through vertically without spreading horizontally.

Aphids regularly infest the Ribes leaves but are controlled by several applications of Malathion as needed. Not much damage is noted from leaf eating insects, probably because of the Malathion. A slowly increasing

infection of powdery mildew is occuring in the R. bracteosum and a lime sulfur spray program is planned next spring to control it. Some deer browsing occurs but it has not yet been a serious problem.

Since most species of Ribes are shade loving, the garden area is covered with 55% shade cloth from late May until the leaves are shed.

Bob Weaver
July, 1982

INOCULUM MANAGEMENT AT DORENA

A basic knowledge of the life cycle of white pine blister rust (Cronartium ribicola L.) is a necessary starting point for an understanding of the management of the rust inoculum. The rust is heteroecious; that is, it requires two hosts, five needled pines such as western white or sugar pine, and currants or gooseberries (Ribes spp.) to complete its life cycle. The stages of this life cycle are described on Table I. Two stages of the life cycle are found on the pine, and two on the Ribes.

At Dorena, the first step of inoculum management is the collection of aeciospores. Aecia are collected at the start of aeciospore shed which occurs during mid May to early June, depending on weather conditions. Collection is done at eight sites distributed within the natural range of the white pines. Cankers are put in large paper sacks, which are labeled per site, brought to Dorena and spread to air dry, facilitating the release and shed of the aeciospores. When dry, the cankers are shaken and scraped with a blunt instrument, releasing the spores into a one-hundred mesh soil sieve which is used to separate spores from any large particles and needles. Spores from each site are kept separate from the extraction process and sieves are washed with alcohol and allowed to dry before subsequent use to prevent contamination of spores from the different sources. The spores are stored in air tight jars at approximately 38^{0} F (3.3^{0}c) until needed.

In mid June, the Ribes garden is inoculated with a mixture of the aeciospores. First, the number of gallons of water required to mist the garden is estimated. Using 4 cc of spore mixture per gallon of water, the total amount of spores required is calculated. Approximately equal parts from each collection site are used to make up the aeciospore mixture.

The correct amount of spore mixture is then added to distilled water in gallon jugs, which are shaken to disperse the spores. Quart sized handspray bottles, available at most nursery suppliers, are used to apply the inoculum to the underside of the Ribes leaves. A foggy overcast warm day is ideal for inoculation, however, in 1982 excellent results were obtained by spraying on a cool evening during the middle of a hot spell.

In Dorena's environment, development of uredia is observed approximately 20 days after inoculation. Water is applied at that time in a fine mist which promotes reinfection of the Ribes leaves by uredospores. This procedure ensures adequate inoculum coverage over the surface area of the leaves.

Telia develop during early September which corresponds with telia development in the field. Leaves covered with telia are collected and used for the inoculation of the sugar pine and western white pine seedlings.

To ensure an adequate amount of inoculum for fall, several patches of Ribes on the Cottage Grove Ranger District are also inoculated with aeciospores in early summer. Procedures identical to those described for the Ribes gardent are followed on the district.

Naturally infected leaves are also collected in September from areas throughout Region 6 to provide a diversity of rust populations. Leaves from all sources are then mixed when used during inoculation of the pines.

Kim Mahlein
July, 1982

TABLE I.

STAGE-STRUCTURE-SPORE TYPE	HOST	SPORE CELL TYPE	INDICATIONS OF SPORE DEVELOPMENT AND SPORE FUNCTION
0 - Pycnia - Pycniospores	5-needle pines	haploid	Sweet, amber colored fluid exuded from young cankers. Sexual function.
I - Aecia - Aeciospores	5-needle pines	binucleate	Bright yellow-orange, thick walled spores produced in cankers. These spores cannot reinfect pine but are blown long distances where they may infect alternate host. Spores remain viable several months under favorable conditions. (Boyce, 1948)
II - Uredia - Uredospores	Currants and Gooseberries	binucleate	Orange swellings on bottom leaf surfaces. Spores reinfect leaves to form more uredia as long as conditions favorable, up to 7 generations (Baxter, 1952) or more (Boyce, 1948) in a summer.
IIIa - Telia - Teliospores	Currants and Gooseberries	binucleate	"Hairy" protrusions on underside of leaves. Product of uredosori development or new infection caused by uredospore when weather cools in fall. Teliospores are not dispersed but germinate in place in telial columns during warm, humid conditions.
IIIb - Basidium - Basidiospores (Germ tube of teliospore)	Currants and Gooseberries	haploid	After teliospores germinate, meiosis occurs to produce four basidiospores. The tiny thin walled basidiospores are subject to desiccation. High humidity and cool temperatures below 68-69° F (Hirt, 1942) are necessary for high infection of pine needles.

Stop # 3

GREENH@USE

CLONAL BANK - FIELD 14

You are standing in what is known to us as field 14, a 14 acre western white pine breeding arboretum that has been, and is used as a seed source for reforestation. A majority of the trees are 25 years old; an additional major planting accurred in 1968. Over the past 3 years approximately 60 grafted trees from selected parent trees have been planted here each year.

Replicates of 172 families are growing in this orchard, representing 19 breeding zones. Since 1980, approximately 1000 or more control crosses have been completed each year, comprising 130 possible combinations. The mating scheme is designed such that families with different resistant mechanisms are specifically mixed, ultimately to produce seed for evaluation plantations.

The logistical problem of the selective cross pollination project can only be appreciated when one realizes the implications of phenology when coupled with the range and number of breeding zones represented in this orchard. Depending on the weather and other factors, the range in the pollination period may be as little as 2 weeks or extend as long as 6 weeks.

When favorable conditions exist and the pollination project is rapidly progressing, crew organization and proper equipment management is essential. For this we rely in part on accurate record keeping, daily scheduling and review of progress, and mapping of the proposed travel route in the orchard to be completed that day.

The project continues several weeks beyond the completion of the work in this orchard as the sugar pine diallels are completed, and any necessary field pollination of the ortets in Region 6 is done. Meanwhile, pollen must be collected, processed, tested and made available for use.

Another project of major proportions which takes place each year is cone collection. Logistics again play a major role in this project as cone maturity follows different patterns related to breeding zone. Cone surveys begin sometime during the first week of August, and continue until a reliable pattern is established which indicates the order of collection. Surveys generally continue into the actual collection process for the clones with later development.

Last years cone crop represented a milestone in Dorenas' history when approximately 1500 bushels were collected. 242 pounds of rust resistant seed was extracted from these cones, enough to plant nearly 6,000 acres. One and ½ to 107 pounds of seed per breeding zone was collected from 13 breeding zones and distributed to 5 National Forests.

All this work is facilitated through the use of manlifts, which must be capable of reaching the top of the highest trees in this orchard - over 50 feet. In the spring which insect bagging occurs, a manlift supplied with a track system is essential to enable movement throughout the field. Lifts with rubber traction tires are sufficient during the drier months of the year.

Maintenance of the orchard consists primarily of routine vegetation management, that is - mowing. The field is usually moved 3 times during the months of May through July and possbily again later in the summer.

Tillage around the perimeter of the field, and also across it in both directions devides the field into 4 blocks of approximately equal tree populations and gives some measure of fire protection in the event of a grass fire.

The newly planted grafted trees require continual attention to insure their health. Prior to installing the mulch you see, this year, competing vegetation had to be removed by hand from each tree. When these trees have grown sufficiently, all limbs below the graft union are removed. Irrigation is also essential when rainfall is not sufficient during the dry months of the year. This is accomplished with our modern 200 gallon spray tank pulled behind a tractor or truck.

An efficient fertilizer scheme is being developed to insure a large cone crop and maintain the vigor of the trees. Fertilizer was applied this year by hand with Cyclone spreaders at a rate of 70 pounds of actual nitrogen per acre. The fertilizer used was ammonium nitrate, and was spread in an area out to or beyond the drip line of each mature tree.

When the trees have reached an adequate height and girth, the lowest whorls are pruned off to facilitate safe operation of equipment during mowing, cone collection and pollination.

As the years come and go, the cycles of work here come and go with them. Adopting the lates and best techniques to our projects plus innovations of our own, will insure our status as Dorena Tree Improvement Center.

Jerry Berdeen
July, 1982

TABLE 1

Two insect species cause significant western white pine seed loss at Dorena Tree Improvement Center

Western Conifer Seedbug, Leptoglossus occidentalis, Truebug.
Overwintering adult become active during May at Dorena. Eggs hatch late May to June both adult and nymphs feed on developing seed in second year cones. This insect is not host specific.

Fir Conework, Dioryctria abietivorella, A conemoth.
Egg deposition takes place from mid Une to July at Dorena. Eggs are deposited on the outside of second year cones. Larvae bore into cones and feed on the cone tissue and seeds around the cone axis. Larvae leave the cones during September to pupate in the ground litter. This insect is not host specific.

TABLE 2

Two insects causing WWP seed loss - Dorena

Year	Cone Treatment	Seedbug (%)	Coneworm (%)	Other Causes (%)	Viable Seed Yield (%)
1975*	CB	5.1ns	0	0.1	94.8
	PB	11.0ns	0	0.1	88.9
	X	67.3**	36.7	0.6	32.1
1976*	MB	0	0	2.2	97.8
	X	15.7**	64.8	0.3	84.0
1977	MB	5.3	0	0.3	94.4
	X	71.4**	68.6	0.7	27.9

* Douglas Fire cone production adjacent to WWP seed orchard

CB - cloth bag
PB - paper pollen-tector bag
MB - mesh bag
X - exposed

TABLE 3

Orthene used to increase viable WWP seed yield by controlling insect damage - Dorena 1981

Treatments	Replications (%)						Mean
XX	81.1	84.1	90.2	83.4	96.3	93.6	88.1ns
TX	90.3	91.8	92.4	91.3	89.8	-	91.1ns
XT	88.4	90.4	93.1	87.7	84.8	85.6	88.3ns
TT	97.0	95.6	98.4	98.9	88.5	97.6	96.0**

X - untreated
T - treated

Analysis of variance (one way) using arcsine transformation.

RUST TESTING

NURSERY OPERATIIONS AT DORENA TREE IMPROVEMENT CENTER

Purpose:

1) Grow seedlings for rust resistance screening program. Sugar pine, western white pine, and lodgepole pine seedlings are grown.

2) Grow seedlings for grafting stock which will ultimately be grafted with scion material from selected resistant trees. Stock will be grown one year after grafting and then planted in seed orchards on the forests.

Planting Frames:

Seedlings are grown in 3½" X 4' planting frames which are constructed out of 3/4" plywood and fitted onto polystyrene pallets. The pallet allows the frames to be moved from place to place with a skid-loader. Seedlings are grown in the frames at least seven years. At the end of the second year the frames are moved into the innoculation chamber for innoculation, and then they are moved back out to the nursery where they are grown and evaluated over a period of five years.

Soil Mix:

Our present soil mix is a mixture of 50% peat moss and 50% sand. The mix is mixed in a concrete truck and then dispensed into the planting frames. A tent is built around the planting frames and the soil mix is fumigated with methyl bromide to reduce the damping-off hazard.

We are testing five commercial soil mixes for possible future use. These mixes are made of 50% peat moss and 50% vermiculite. Four of them come with fertilizer mixed in. These mixes have a higher initial cost but several savings would result from their use. Material handling would be drastically reduced. Since these mixes are made from essentially sterile materials, the need from soil fumigation is eliminated. Preliminary observations indicate that seedlings growing in some of these media are superior in uniformity and disease resistance to those in our present mix.

Sowing:

Sowing is performed by hand to insure accuracy. Mechanical procedures have been tried, but none have proved as accurate as the hand procedures. Meticulous care must be maintained to insure that the proper seed gets placed in the proper position. Inability to accomplish this simple task properly would invalidate all our rust screening efforts.

Seeds are planted in individual planting spots and covered with silica sand. In 1981 we experimented with covering each frame with a layer of coarse silica grit to control moss and weeds and to moderate extremes in soil surface temperatures. The grit worked marvelously, but this year its price soared to $204 a cubic yard.

Irrigation:

Water for irrigation obtained from the Row River. A pump is located next to the river, 0.8 miles away. Underground pipes service the nursery area and several of the orchards. The Ribes garden and greenhouse are on city water.

In the last two years we have improved our irrigation system to provide better distribution of water. Shrub heads with head to head coverage are now being used in place of Rainbirds. This year solenois valves have been installed to control each station, and a computerized control box has been installed to control watering time to each station.

Fertilization:

Prior to sowing, a fertilizer formulation prepared by our Regional Office is applied. Nutrient levels are monitored throughout the growing season. Fertilizers are applied as needed to keep nutrients at desired levels.

We are currently developing laboratory facilities capability to do our own soil testing. Presently, we have to send soil samples to OSU which takes two months waiting period to get results.

Grafting Stock Area:

Grafting stock is grown in 4-5 gallon poly pots. Stock will be grafted in the pots and then sent out to the forests for planting in seed orchards after a minimum of one more year at Dorena.

Bill Sery
July, 1982