Increased Seed Yields With a Mist Blower That Distributes Pollen in Loblolly Pine Seed Orchards

R. A. Brown

Seed orchard supervisor (retired), Champion International, Tillery, NC

*Seed yields were increased in orchards in which air streams from a mist blower were used to improve the distribution of seed orchard pollen at the time when female flowers (megasporangiate strobili) were most receptive. The average yield in a loblolly pine (*Pinus taeda *L.) seed orchard for 2 test years was 23% better than the previous best year's yield, 29% better than the average of the previous best 4 years' yield, and 48% better than the average yield for 11 crop years.* Tree Planters' Notes 38(4): 3- 5; 1987.

Several loblolly pine seed orchards at the Eastern Carolina Seed Orchard complex near Tillery, NC, supply improved seed for all reforestation by Champion International in its Eastern Carolina region. Regional requirements for improved seed have exceeded orchard production for the past several years, primarily because of severe insect infestations and late spring freezes. The need to increase seed production was apparent. In addition to more aggressive insect control measures, one possible way to increase seed production was to improve pollination efficiency.

Large quantities of pollen can be circulated in the seed orchard by passing beneath seed orchard trees with a mist blower directed at the crown of trees when pollen is being shed. The hypothesis is that this practice increases the number of pollen grains per ovule, reduces selfing, and increases seed yields *(2).*

In this paper, I present a procedure that increases pollination efficiency and subsequently may increase seed yields.

Methods and Materials

During early April 1980, the development of male flowers (catkins, or microsporangiate strobili) was monitored to determine the major pollen release date. Observations established April 12 as the probable date of major pollen flight. Air blasts from a Hardi-Combi I mist blower mounted on a 2640 John Deere tractor were used to blow pollen from catkins on the nights of April 11 and 13, 1980.

Blowing of pollen was not begun until winds were less than 2 miles/hour. The air blast was directed along the outer edge or face of tree crowns. This angled air blast deposited released pollen two to four rows away. Each orchard row was blown in the same direction so that most trees were repeatedly exposed to massive pollen clouds. Air speed at the mist blower head was in excess of 100 miles/hour. High air speed is necessary to dislodge pollen from catkins and move it to adjoining rows. Floodlights mounted on the tractor illuminated the trees so that air blasts could be adjusted for tree height and crown position.

At the time of first treatment, the female flowers were late stage 4 or stage 5 (1). With few exceptions, female flower development was stage 5 at the second treatment. The same general treatment method was used on all orchards 1 year later in April 1981.

In 1980 a portion of one orchard was left untreated to evaluate the effectiveness of the mist blower pollen distribution treatment. Conelets were collected from ramets of two clones in both treated and untreated areas of the orchard. Dissection of the ovules and pollen grain counts were performed by North Carolina State Tree Improvement Cooperative personnel.

Results

A comparison of pollen grain counts from mist blower treated and untreated (naturally pollinated) areas indicated that the mist blower treatment increased the average number of pollen grains per ovule (table 1). The increase in number of pollen grains per ovule is evidence of the increased pollination efficiency using the mist blower method.

Table 1—*Average number of pollen grains per ovule*

Clone	Untreated area	Treated area
6–20	3.7	4.9
6–22	4.7	4.8

Values are averages of 20 conelets per clone per area.

Pounds of seed per bushel of cones is a common unit of measure to compare seed yields. Seed yields per bushel of cones for the two test years (pollinated in 1980 and 1981) were substantially greater than years when mist blower pollination was not employed (table 2).

Average yield during the two test years (harvested in 1981 and 1982) was 23% higher than the previous best year yield, 29% higher than the average of the previous best 4 years' yield, and 48% higher than the average yield of 11 years that did not receive mist blower pollination treatment.

Table 2—*Southeastern operation seed orchard yields by year*

Year harvest	Yield (lb. seed/bu cones)
1971	1.18
1972	1.60
1973	1.60
1974	1.44
1975	1.47
1976	1.75
1977	1.28
1978	0.94
1979	1.64
1980	1.48
1981	2.19
1982	2.13
1983	1.40

Seeds were harvested the year after pollination.

Discussion

The actual mechanism(s) by which seed yields are increased by using the mist blower pollen are probably a combination of the following factors. In addition, the effect of foreign pollen within the orchard is greatly diluted by the massive amounts of orchard pollen that are dislodged by the mist blower method, and, therefore, the genetic integrity of orchard seed can be maintained.

- Pollen of high viability is presented to the female flowers at their most receptive stage.
- The timing of pollination can be optimized. Because optimum receptivity of female flowers varies between clones, multiple treatments can be made to ensure pollination of both early and late flowers.
- Pollen droplets emerge from the female flowers primarily at night during stage 5 of flower development. Therefore, using a mist blower at night should increase the number of pollen grains transported to the ovule.
- Higher pollen grain counts per ovule can be obtained and may help decrease first-year ovule abortions.
- A thorough mixing of pollens from many trees in the orchard should occur when air blasts are used, reducing the probability of self-fertilization and thus contributing to higher seed yields. Self-fertilization usually results in first-year ovule abortions and reduced filled-seed percentages.

Conclusions and Recommendations

This inexpensive method appears to increase both the efficiency of pollination and seed yields. Seed yields for the years the mist blower method was used were higher than yields of previous or subsequent years, and we concluded that the mist blower treatments were responsible for these seed yield increases. The mist blower method to increase seed yields in loblolly pine seed orchards is recommended for operational use. Under our conditions this treatment cost about $12 per acre.

This mist blower pollen distribution method will continue to be evaluated in this orchard to determine the range of application and to quantify the magnitude of response.

The following guidelines are suggested for applying the mist blower pollen distribution method:

1. Treat orchards as soon as female flowers are receptive and pollen can be blown from catkins.
2. If possible, treat orchards in late evening or night when winds are calm and pollen droplets are exposed.
3. Angle air blasts along the face of tree crowns so that pollen will be deposited several rows away.
4. Blow pollen from tree rows in the same general direction

so that nearly all trees will be exposed several times to pollen clouds.

5. Maintain tractor ground speed at about 3 miles/hour or less to avoid distorting the air blast column.
6. Repeat treatment of orchards 2 to 4 days later when late flowers are receptive.

Literature Cited

1. Bramlett, D.L.; O'Gwynn, C.H. Recognizing developmental stages in southern pine flowers: the key to control pollination. Gen. Tech. Rep. SE-18. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1980. 14 p.
2. Bridgewater, F.E.; Trew, J.F. Supplemental mass pollination. In: Pollen management handbook. Agric. Handbk. 587. Washington, DC: U.S. Department of Agriculture, Forest Service; 1981: 52-57.