MIST PROPAGATION RECOMMENDED FOR, EXPANDING COTTONWOOD CLONES RAPIDLY

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Eastern cottonwood clones can be rapidly expanded by removing 6-inch sections from elongating shoots of parent plants, placing them in a rooting medium, and spraying them lightly with a water mist. The procedure is relatively inexpensive and the equipment needed is not elaborate.

The Southeastern Area for State and Private Forestry (USDA Forest Service) will soon distribute limited numbers of cuttings from eastern cottonwood *(Populus deltoides* Bartr.) clones selected for pulpwood and timber production in the Lower Mississippi River Valley. To produce sufficient numbers for field planting, nurserymen will have to vegetatively propagate their cuttings. Mist propagation is recommended for expanding cottonwood clones rapidly. This system is used by horticulturists, and has proven reliable in experimental and production nurseries in the Midsouth and in Europe (Koster 1968).

General nursery procedures appropriate for cottonwood are described in the following paragraphs. The misting technique is detailed, along with procedures for planting cuttings rooted by mist propagation.

General Nursery Requirements and Procedures

A fertile and well-drained sandy loam or silt loam soil is best for a cottonwood nursery (Broadfoot 1960). The nursery should have only enough slope to permit satisfactory surface drainage and be readily accessible by an all-weather road. A liberal supply of water is needed, preferably well water, since it is less likely to contain weed seeds or harmful chemicals than that from streams or drainage canals.

In preparation for planting of cuttings during the dormant season, nursery beds should be disked repeatedly the preceding summer and fall to eliminate established vegetation, and then leveled with a land plane.

Cottonwood cuttings should usually be spaced 12 to 18 inches apart in rows 36 to 40 inches apart in nurseries, but wider spacings, as much as 6 by 6 feet, should be considered for the limited number of cuttings that will be initially available. This promotes side branching, providing an additional source of material for cuttings.

Cuttings should be handled and stored as described by McKnight (1970). They must not be permitted to dry out, and should be soaked in water for 48 hours before planting.

The standard length for field planting is 20 inches, but 12-inch cuttings are satisfactory for nursery work. They should be placed butt downward in a hole or trench to a depth that leaves 2 inches of stem above the soil surface.

Losses

A few simple precautions will minimize the risk of losses to diseases and pests. On properly selected sites, few diseases will be a problem. Occasionally, the fungus *Septoria musiva* Peck may cause leaf spotting and small cankers on stems (Bier 1939). Since windborne ascospores of this fungus are discharged from surfaces of leaves on the ground in winter (Waterman 1954), it is probably advisable to plow leaves under in the fall. Deer strip and eat new cottonwood foliage during spring and summer, and rub their antlers against stems in the fall. A fence should be constructed to exclude the deer. Fencing to exclude rabbits is seldom necessary.

Serious losses to cottonwood leaf beetles

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((Chrysomela scripta F.) and cottonwood twig borers *(Gypsonoma haimbachiana* Kearf.) can be prevented during most of the first year after planting by treating cuttings with phorate (Morris 1960). Despite this treatment, these insects may attack during the last few weeks of the growing season. Foliar sprays have prevented serious losses at that time.

The identities of individual clones must be maintained to permit selection of those best for individual planting situations. A good rule is to discard any doubtful material. Each clone should be assigned to a single block. To prevent mixing, only a single clone should be handled at a time and a tray should contain cuttings from only one clone. It is helpful to number the blocks and make a planting map for the nursery.

Material of different ages should *not* be planted together. Unless there is some separation, plants established late in the growing season will be quickly suppressed by those established earlier.

Misting

In eastern cottonwood, leaf-free cuttings in which the tissues have hardened (hardwood cuttings) root readily when taken in the dormant season. In other seasons, cuttings with succulent tissues and attached leaves (greenwood cuttings) root more quickly and are more likely to survive than hardwood cuttings if treated as recommended. Furthermore, large numbers of greenwood cuttings can be taken from branch tips without appreciably damaging or impairing the growth of the parent plants.

The problem with greenwood cuttings is that they must be kept moist while rooting (Raines 1940, Hartmann and Kester 1968). Moisture is most efficiently provided by intermittently spraying with mist, which forms a film on the leaves and lowers their surface temperature, lessening the amount of water lost by transpiration.

Equipment

Mist bed.-The basic components of a mist bed are benches on which to place potted cuttings, a horizontal pipe with risers for spray nozzles, a solenoid valve to control the water flow, and timers to activate the valve (fig. 1). Mist beds can be constructed on the ground or elevated to a convenient working level of about 36 inches. The size and number of propagating benches will depend upon the size of the operation. A bench 3 feet by 12 feet will hold 1,024 cuttings planted in 2-1/4-inch-square peat pots. A drainage system must be installed to carry off surplus water if the cuttings are rooted in a ground bed.

A windbreak is needed around the sides of the mist bed. A 2-foot-high wooden frame, hinged or removable and covered with clear plastic or burlap, prevents the wind from blowing the mist off the 'cuttings. The bench generally need not be covered except to protect the cuttings and pots from damage during hard rains. A removable top can be constructed and covered with clear plastic.

Water.-With intermittent mist operation, 7-1/2 to 11 gallons of water will be used per square foot per week; when mist is continuous, water consumption will be about 30 gallons per square foot per week. The quality of the water is very important. Excessive amounts of iron and sodium in the water will clog the nozzles and leave a deposit on the leaves which may kill them (Farmer 1963).

Plastic or galvanized iron pipe 1/2 inch in diameter is suitable for plumbing the mist bed. A line strainer should be installed in the line between the pump and a solenoid valve. A normally open solenoid is preferable to a normally closed one because in the event of a power failure, the valve remains open, providing a continuous flow of water. Mist nozzles generally cover an area 3-1/2 feet in diameter. A finer mist is produced when the system is operated at high pressures; maximum efficiency is at about 70 psi (O'Rourke 1949).

Timers.-Two different timers are needed. One regulates both the mist period and the interval between mistings. The other, a day-night timer, lengthens the interval between mistings at night. An alternative method is the use of an automatic control that has a wire screen leaf connected to a mercury switch. When the leaf is wet, it falls and shuts off the mist. When the leaf dries, it rises, allowing water to flow.

Pots *and* trays.-Peat pots 2-1/4 or 3 inches square should be filled with a 2:1 mixture of sand and peat moss. Before filling, a hole 1/4 inch in diameter should be made in the bottom of the pot so that during the rooting process excess water

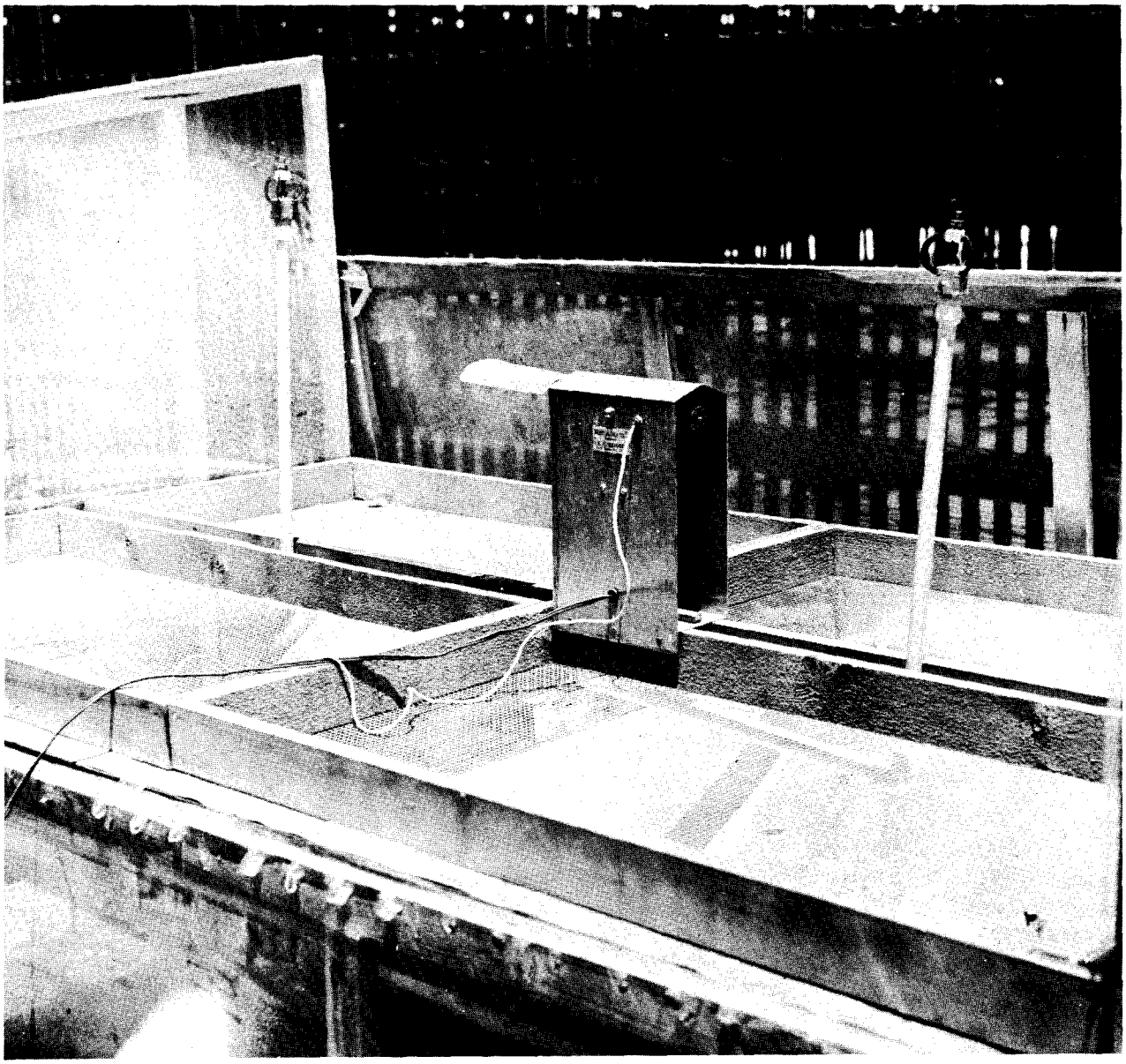

Figure 1.—Inside of mist chamber with automatic mist control.

will drain away. Peat moss is needed to increase the water-holding capacity of the rooting medium.

Wooden trays 2 to 2-1/2 inches deep with a hardware cloth (1/4-inch mesh) bottom and inside dimensions of 18 by 36 inches hold 128 2-1/4-inch square peat pots. These trays hold the pots during the rooting process and are useful for transferring them from the mist chamber to the field.

The afternoon before cuttings are collected, the trays with their filled pots should be placed in the mist chamber and saturated with water.

Propagation of Greenwood Cuttings

Collection and potting.-Greenwood cuttings can be taken in the spring as soon as the new shoots are 10 to 12 inches long. Thereafter, cuttings can be taken from the same plants when they have elongated at least 5 to 6 additional

inches. In the spring, when growing conditions are ideal, cuttings can be taken every week to 10 days. As the season progresses, side branches develop on the main stem of the parent plant, and if cuttings are taken ' from them rather than the main stem, the plant will reach a height of 10 to 16 feet by the end of the growing season. This switch will be an ideal source for hardwood cuttings in the dormant season.

Greenwood cuttings should be made with a sharp knife or pruning shears. They should be placed in an ice chest or a tub of cold water, or covered with sphagnum moss while being transported to the mist chamber. Cuttings must not be exposed to the direct rays of the sun or allowed to dry out.

During potting, all but three or four of the uppermost leaves should be removed. If the top leaves are very large, portions of them can be cut away to avoid shading the adjacent cuttings. A sharp knife should be used to remove a portion of stem to expose fresh tissue. The remainder should be no longer than 6 inches. The basal portion of the cutting is inserted into a small hole made in the rooting medium. The cutting should be pushed as deeply into the pot as possible without damaging it or pushing it through the bottom. The rooting medium should be gently packed to
secure the cutting in an upright position.

Cuttings should be placed under the mist as quickly as possible. If a shaded work area is not available, the cuttings should be prepared and inserted into the pots directly under the mist.

Mist frequency.-Mist must be regulated so that the leaves are never completely dry. An automatic control device may not be as satisfactory as timers. Wind tends to upset the balance of the leaf, and any foreign substance on the bearings, leaf, or counterweight seriously interrupts the mist cycle. Intermittent mist is preferable to a continuous spray because it does not lower the temperature of the rooting medium, thus causing slow root development. Another disadvantage of continuous mist is that it often leaches some of the mineral nutrients from the leaves (Long *et al.* 1956). The misting frequency required depends upon ambient temperature and relative humidity. Generally, 3 to 4 seconds per minute will be sufficient during the heat of the day. However, on excessively hot days (95°-100°F), two to four 2-1/2-second mist periods per minute are necessary. The interval between mistings can be longer at night than during the day; on some nights misting may not be necessary.

The cuttings should be left in the mist bed for a week to 10 days or until roots begin to appear through the sides and bottoms of the pots. Before outplanting, they need to be hardened off (conditioned to withstand field conditions) by gradually reducing mist frequency. In the Lower Mississippi Valley, this operation should be carried out under 25 to 50 percent shade. Two or three 6-second mist periods per hour are needed during the first day. On the second and third days, only a few mist periods per day are needed, just enough to keep the pots moist. A clock timer can be used for this process. Usually the rooted cuttings will be ready for field planting after 3 days of conditioning..

Outplanting Rooted Cuttings

Before outplanting, the beds should be prepared in the same way as for hardwood cuttings. Rows should be 36 to 40 inches apart, with the rooted cuttings spaced 12 to 18 inches within the row. Spacing can be modified to facilitate mechanical cultivation.

The pots can be planted with hand tools or a planting machine.

Before outplanting, the pots must be completely saturated with water, and then watered again after being set in the field. If the rim of a pot is exposed, it acts as a wick, and the wind and sun will soon dry the entire pot. A light cultivation soon after planting will cover the rims.

At least five or six cultivations are needed during the growing season to maintain rapid growth by eliminating competing vegetation and improving the soil condition. A straddle cultivator mounted on a small wheel tractor does an excellent job when the plants are small. As they grow taller, a rototiller will control late season weeds, but in problem areas, some hand hoeing may also be necessary.

The plants may be irrigated by a series of ditches and levees or a pipe and sprinkler system. The first method is less costly but uniform coverage is often difficult to obtain. An advantage of the sprinkler system is that less labor is required when irrigating.

The addition of fertilizer may not be necessary if the site is inherently fertile, has a nearneutral soil reaction, and has not been farmed in recent years. If growth is slow, however, and the color and size of the foliage indicate that there may be nutrient deficiencies, soil amendments are needed. Nitrogen deficiency will affect the whole plant, causing a uniform reduction in the leaf size. A lack of phosphorus causes a slight reddening in the main veins of the leaves. Low potassium levels prevent the leaves from attaining their normal size, and interveinal areas are a greenish-yellow with cream colored spots (Hacskaylo *et al.* 1969).

Harvesting

Before cutting the switches during the dormant season, the side branches should be removed with either a machete or a hand pruner. Any branch large enough to make a cutting should be saved. Switches should be cut 6 inches above the ground with a machete or saw, tied in bundles, and labeled. The cuttings can then be replanted in the nursery to further expand the clones or they can be planted in the field.

The number of cuttings that can be produced by mist propagation depends upon weather conditions and the clone's inherent survival and growth rates. During one growing season, it is possible to produce 25 to 200 hardwood cuttings from a single cutting.

Literature Cited

Bier, J. E.
1939. *Septoria* canker of introduced and native hybrid poplars. Can. J. Res. 17: 195-204.

Broadfoot, W. M.
1960. Field guide for evaluating cottonwood sites. USDA Forest Serv. USDA Forest Serv. S. Forest Exp. Sta. Occas. Pap. 178, 6 p.

Farmer, R. E., Jr.
1963. Distilled-water mist chamber for propagating greenwood cuttings. Tree Planters' Notes 59: 28-29.

Hacskaylo, J., Finn, R. F., and Vimmerstedt, J. P.
1969. Deficiency symptoms of some forest trees. Ohio Agr. Res. and Develop. Center Res. Bull. 1015. 68 p.

Hartmann, H. T., and Kester, D. E.
1968. Plant propagation principles and practices. Ed. 2, 702 p. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Koster, R. W.
1968. Outdoor propagation from leaf cuttings of *Populus deltoides,* balsam poplars and hybrids. Int. Poplar Comm. 13th sess., 13/3, 9 p.

Langhans, R. W.
1955. Mist for growing plants. Farm Res. (Cornell Univ.) 21(3): 3.

Long, W. G., Sweet, D. V., and Tukey, H. B.
1956. The loss of nutrients by leaching of the foliage. Mich. Agr. Exp. Sta. Quart. Bull. 38: 528-532.

McKnight, J. S.
1970. Planting cottonwood, cuttings for timber products in the South. USDA Forest Serv. Res. Pap. SO 60, 17 p. S. Forest Exp. Sta., New Orleans, La.

Morris, R. C.
1960. Control of cottonwood insects with a systemic insecticide. J. Forest. 58(9): 718.

O'Rourke, F. L.
1949. Mist humidification and the rooting of cuttings (Progress report). Mich. Agr. Exp. Sta. Quart. Bull. 32: 245-249.

Raines, M. A.
1940. Some uses of a spray chamber in experimentation with plants. Amer. J. Bot. Suppl. Vol. 27(10): 18s.

Waterman, A. M.
1954. *Septoria* canker of poplars in the United States. USDA Circ. 947, 24 p.

Yarwood, C. E.
1939. Control of powdery mildews with a water spray. Phytopathology 29(3): 288-290.