

Mobile Tree Seedling Coolers

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Two mobile coolers have successfully protected seedlings from exposure to the elements. The two pickup-sized coolers keep seedlings in a temperature-controlled environment while they are being transported from a centrally located storage area to the planting site. A third, non-refrigerated Canadian cooler can be useful in areas where the temperatures are around 50 /F (10 °C) during planting season. Tree Planters' Notes 44(1):16-18; 1993.

Two mobile coolers have been evaluated by engineers at the Missoula Technology and Development Center (MTDC) (figure 1). The coolers have successfully protected seedlings from stress caused by exposure to heat and the elements. Seedlings must be kept cool, moist, and near dormancy from the time of lifting, during shipment to the planting site, until they can be planted. The pickup-sized coolers transport seedlings from a centrally located cooler to the planting site and then hold the seedlings at the planting site in a temperature-controlled environment. A fully loaded cooler will weigh between 3,000 and 3,500 pounds (1,361 to 1,586 kg). Coolers hold approximately 25 to 30 boxes of seedlings. The coolers are available commercially.

Polar Products Seedling Cooler

The first prototype cooler was built for MTDC by Polar Products of Torrance, California. Polar Products custom-designed a 12-V dc refrigeration system and installed it in a prebuilt canopy. The canopy was constructed of a hardwood frame with white-painted aluminum sheeting on the exterior and stainless steel sheeting on the interior. The walls were insulated with 3½ inches (8.9 cm) of polyurethane foam. Interior shelving was constructed of perforated metal supports and plywood panels. The 12-V refrigeration system could be operated by a generator on the vehicle engine, a roof-mounted photovoltaic array, or standard 117-V ac through a battery charger.

The refrigerator compressor and condensing components were located in a housing on the front of

electronics panel controlled the power source switching and was housed in a weatherproof enclosure on the passenger side of the cab over hang. Refrigeration was provided by a cold plate evaporator, where refrigeration tubes are encased in a solution that freezes at a specific temperature. This type of evaporator is heavier than fin-and-tube evaporators, but the cold plate provides cooling when the refrigeration system is not operating.

Field tests were conducted on the Stanislaus National Forest's Calaveras and Mi-Wok Ranger Districts in the Pacific Southwest Region, on the Siskiyou National Forest's Illinois Valley Ranger District, and the Umatilla National Forest's Walla Walla Ranger District in the Pacific Northwest Region. The cooler performed effectively. In-bag seedling temperatures below 35 /F (1.7 /C) were maintained over the 6-hour period from arrival at the site to the last bag-up. Ambient temperature during the cooler field tests ranged in the mid-50 to 75 /F (12.8 to 23.9 /C) range.

The cooler was also tested at MTDC facilities. Thermocouples and a data logger were used to record air temperatures and cold plate temperature during initial start-up and simulated field conditions. The initial pull-down (the time required to completely freeze the solution in the cold plate upon initial start-up) took about 8 hours. After about 16 hours, the interior air temperatures stabilized and an approximately 2 /F (1.1 /C) temperature differential existed between the top and bottom of the cooler. Temperatures were also recorded under simulated field conditions in 70 /F (21.1 /C) ambient air temperature. The air temperatures inside the cooler increased approximately one degree per hour.

Some users were concerned that the cooler was too heavy and too complicated for their needs. As a result, Polar Products reconstructed the canopy with welded frames of aluminum tubing, which reduced the weight from over 2,000 pounds (907 kg) to 1,800 pounds (816 kg). The refrigeration was changed to operate on 120-V dc and could be powered from an additional alternator on the vehicle engine and by a standard electric outlet

equip the cooler with an ac-powered refrigeration system if the pickup engine operation feature is not required.

Specifications. This cooler is available at the following address:

Polar Products, Inc.
2808 Oregon Court, Bldg. K-4
Torrance, CA 90503
(310) 320-3514

Construction: Frame, welded aluminum tubing
Insulation: 3½ inch (8.9 cm) polyurethane FIP
Outside dimensions: 82 inches x 82 inches x 96 inches (208 cm x 208 cm x 244 cm)

Refrigeration system: 117-V ac operation; hermetic-type condenser; cold plate evaporator

Weight: Approximately 1,800 pounds (816 kg)

Capacity: 25 to 30 boxes

Estimated cost per unit: 1-5, \$14,000; 6-8, \$12,000; 10+, \$10,000,

Isoloc Seedling Cooler

The second prototype seedling cooler was built for MTDC by Isoloc Manufacturing Company of Vancouver, Washington. Isoloc installed an MTDC-designed refrigeration system in a custom-built canopy (figure 1). The canopy walls are constructed of 3½ inches (8.9 cm) of polyurethane insulation sandwiched between plywood panels. White-painted, stucco-embossed aluminum sheeting covers the exterior, while aluminum sheeting lines the interior. Interior shelving is constructed of aluminum H-beams and round aluminum tubing.

The refrigeration system operates on 117 V ac. In the field, refrigeration is provided by the cold plate evaporator. The interior air is circulated by a fan

operating on 12 V dc. The fan is operated by a 12-V, deep-cycle, RV battery. A trickle-type battery charger is permanently wired into the electrical system to recharge the battery when the cooler is plugged in. The battery charger is equipped with a sensor that turns the charger off when the battery is fully charged.

During testing at MTDC facilities, the initial pull-down of the cold plate evaporator took about 9 hours. The air temperature inside the cooler stabilized in about 18 hours. After the air temperatures stabilized, a 25 °F (13.9 °C) temperature gradient existed between the top and bottom of the cooler.

The cooler was tested on the Lolo National Forest's Superior Ranger District in the Northern Region and on the Malheur National Forest's Bear Valley and Long Creek Ranger Districts in the Pacific Northwest Region. In-bag seedling temperatures were about 40 °F (4.4 °C) when placed in the cooler and in-bag seedling temperatures lowered 3 to 6 degrees F (1.6 to 3.3 degrees C) during 8 hours of storage at the planting site. On one occasion, the seedling temperature reached 31.5 °F (-.3 °C) and the cooler door was left open to prevent the seedlings from freezing. The ambient air temperature on that day reached a high of only 52 °F (11.1 °C).

The ac refrigeration system was simple and convenient to operate. The cooler provided adequate cooling to meet the field users needs.

Specifications. This cooler is available at the following address:

Isoloc Manufacturing Company
PO Box 61522
Vancouver, WA 98666
(206) 695-3230

Construction: Wood frame

Insulation: 3 inches (7.6 cm) urethane

Outside dimensions: 96 inches long x 84 inches wide x 79 inches tall (244 cm x 213 cm x 201 cm)

Refrigeration system: 117-V ac operation; 1 hp Copeland Condensing Unit; Dole Truk-Cel Evaporator Unit

Weight: Approximately 2,000 pounds (907 kg)
Estimated cost: \$11,500



Figure 1—Isoloc seedling cooler (left) and Polar Products seedling cooler (right).

Canadian Cooler

A third cooler has been identified that may be useful to nursery managers (figure 2). Horizon Fiberglass Products, Ltd., Delta, BC, Canada, has an insulated, non-refrigerated cooler that may be sufficient in areas where ambient high temperatures are in the low 50 /F (10 /C) range during planting season. The interior and exterior walls are made of molded fiberglass-reinforced plastic and are covered with a clear gel coating. The bottom of the canopy is not molded to fit a particular make of pickup, which allows it to slide into any standard American pickup-bed with an 8-foot box. The walls have 1 ½ inches (3.8 cm) of phenolic foam insulation.

The inside shelving consists of metal supports a plywood seedlings below 50 /F (10 /C). A roof-mounted ventilator allows warm air near the top of the cooler to escape. In tests conducted by the Forest Engineering Research Institute of Canada, air tem-

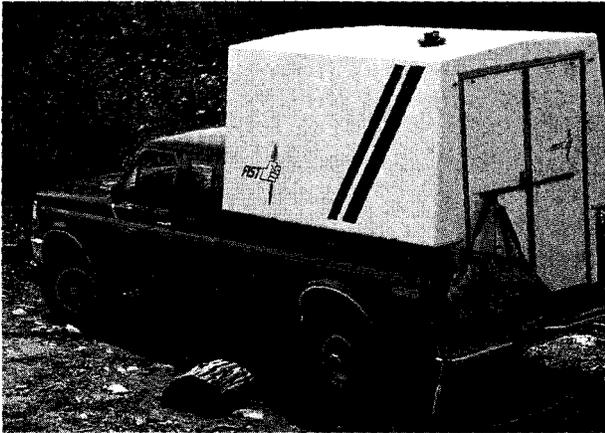


Figure 2—Canadian non-refrigerated cooler.

peratures within the canopy ranged from 45 to 54 /F (7.2 to 12.2 /C) in ambient air temperatures that ranged from 41 to 72 /F (5 to 22 /C). The cooler weighs 450 pounds (204 kg) and is distributed by International Reforestation Suppliers of Eugene, Oregon.

Specifications. This cooler can be obtained from the following suppliers:

Horizon Fiberglass Products, Ltd.
3551 River Road West
Delta, BC, Canada V7K 3N2
(604) 946-8718

International Reforestation Suppliers
2100 West Broadway
PO Box 5547
Eugene, OR 97405
(503) 345-0597

Construction: Molded fiberglass

Insulation: 3-inch urethane

Outside dimensions: 102 inches long x 75 inches wide x 78 inches tall (259 cm x 191 cm x 198 cm)

Refrigeration system: No refrigeration; roof mounted ventilator

Weight: Approximately 450 pounds (204 kg)

Estimated cost: \$4,200 Canadian; \$4,380 U.S. FOB Blaine, Washington

A report documenting the project is available from

USDA Forest Service
Missoula Technology and Development Center
Building 1, Fort Missoula
Missoula, MT 59801