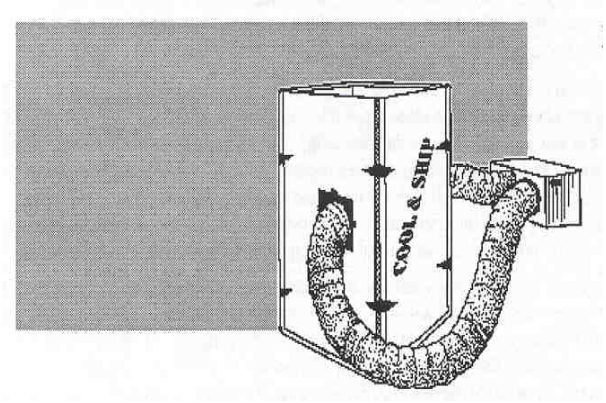
COOL AND SHIP:
A LOW-COST, PORTABLE FORCED-AIR COOLING UNIT



the Southern Region small fruit consortium

Maintaining the Quality of
North Carolina
Fresh Produce

Prepared by
M.D. Boyette, Extension
Agricultural Engineering Specialist

There is growing interest in the commercial production of high-value specialty fruit such as strawberries, blackberries, raspberries, and blueberries. Much of the small fruit grown in North Carolina is currently marketed through pick-your-own establishments or roadside stands. A strong demand for these small fruit items from grocery stores and restaurants has prompted many growers to consider expanding their production to take advantage of these new marketing opportunities.

These commodities, however, are extremely perishable and normally require immediate postharvest cooling before shipping to prevent degradation. Expansion into the commercial small fruit market would usually require a considerable investment in postharvest cooling and handling facilities, and possibly refrigerated transport. The risks associated with a new venture and the considerable cost involved prevent many growers from taking full advantage of this marketing opportunity. Small portable cooling units designed to "plug in" to small, insulated shipping containers have been used by the world's airlines and ocean freight carriers on a limited basis for more than 30 years. These units typically have been utilized for mainte-nance cooling of precooled, highly perishable produce during transit or during extended stop- overs or delays. This publication gives instruction for building and using a similar, inexpensive cooling system. The Cool and Ship system provides rapid cooling for modest amounts of small fruit and is versatile, portable, reusable, and inexpensive. The system uses an air-conditioning system and com- mon building materials, and may be easily assembled by the user.

Why Cool?

Small fruit such as blackberries, strawberries, and blueberries are very perishable and require immediate cooling after harvest to prevent a rapid decline in quality. At warm temperatures, softening and decay can occur in less than four hours. Rapid and thorough cooling is essential to quality maintenance.

The preferred and most commonly used cooling method for small fruit is forced-air cooling. Forced-air cooling uses a refrigerated room equipped with fans that pull large volumes of cold air through palletized packages of produce. The close contact between the moving, cold air and the warm fruit causes a much more rapid decrease in temperature than would occur otherwise. In addition, forced-air cooling removes droplets of water (dew or rain) from the surface of the fruit. Warm, wet fruit is very susceptible to postharvest rots.

Although growers sometimes receive a premium price for cooled produce, the benefits of cooling are often more indirect. They may include better appearance, a much longer shelf life, and the pride that comes from marketing a high-quality product. However, the most important indirect benefit is the marketing advantage cooled produce has over uncooled produce. In a buyer's market, with other factors being equal, cooled produce always sells better because buyers associate cooling with quality.

Advantage of the Cool and Ship System:

Inexpensive - low initial cost compared to a stationary cooling facility.
Reusable - can be disassembled for easy transport.
Transportable - no need for a refrigerated truck.
Versatile - can be used for a variety of produce.
Energy Efficient - takes less energy than a stationary facility.
Protects the produce - prevents condensation or contamination.

Equipment

Building the Cooling Container

The cooling container shown in the centerfold drawing consists of a top,bottom,and four side panels of 2-inch-thicksheets of extruded polystyrene insulation, commonly referred to as blueboard. This insulation material is manufactured in panels measuri 4 feet by 8 feet, is safe for use as food packaging, and is reasonably durable when handled with care. Sheets of polystyrene bead (whiteboard) may be substituted for blueboard, but they are not nearly as durable.

A sheet of 1/4-"-thick CDX-grade plywood or chipboard is bonded to the insulation material for added rigidity and protection from damage. Exercise care when selecting the adhesive. A white glue compatible with both the wood and the polystyrene insulation material must be used. Spread the glue evenly in a thin layer on the insulation board with a brush or wide putty knife. Carefully position the plywood on the insulation and firmly press together. As the composite panels are completed, they may be stacked one upon the other on the floor or other flat surface. Adding weight to the top of the stack is beneficial because full contact between the plywood and insulation is essential for a strong bond. Be careful to wipe off any excess glue that squeezes out between the panels. Five full-sized

panels are required for each container (4 for the sides and I cut into halves for the top and bottom).

Considering the size of the fruit packaging is important when building the cooling container. The inside dimensions of the container shown in the drawing are 40 inches deep by 44 inches wide by 72 inches tall. It will hold 144 half-pint masters, 96 pint masters and 60 quart masters while still providing sufficient void space for proper air circulation. Al- though desirable, it is not necessary that the cooling container be completely full. The pictorial view of the drawing shows an acceptable fill of 84 1 2-pint masters. The top of the cooling container is designed to move vertically, as shown in Figure 1, to accommodate various stack heights. This arrangement allows a tight fit and eliminates air short-circuits over the top of the stack of masters.

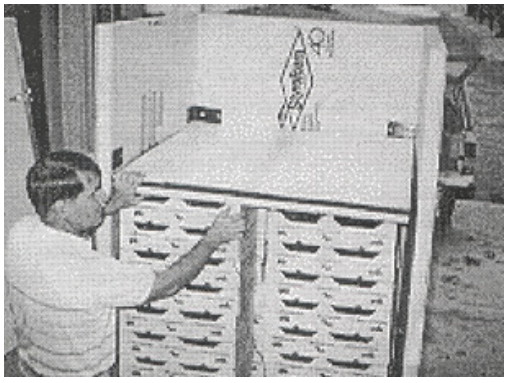


Figure 1. Fitting the top in place.

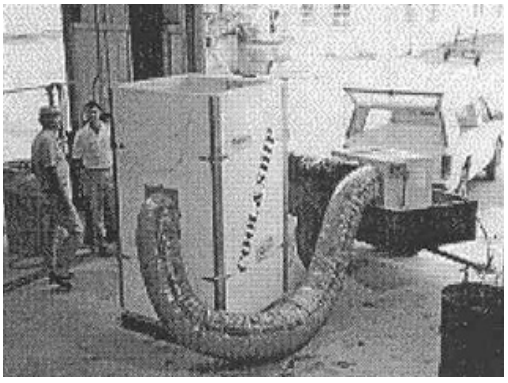


Figure 2. Air conditioning unit with cooling container.

T'he maximum outside dimensions of the cooling container (as shown in the top views of the centerfold drawing) was limited to 48 inches because of the maximum size of the materials. However, this size is also convenient because it will fit between the wheel wells of a full-size pickup truck. An inlet and outlet plenum or air gap (also shown) of at least 1 1/2 inches must be maintained on either side of the stack of masters for air distribution. Cold air inlet and outlet holes, the size of the air distribution ducts, are cut in the center of opposing sides adjacent to the two plena. The cutouts are saved and used to seal the holes once cooling is completed.