University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Historical Materials from University of Nebraska-Lincoln Extension | Extension

2003

NF03-582 Early Season Extentstion Using Hotcaps

Laurie Hodges
University of Nebraska at Lincoln, lhodges1@unl.edu

Follow this and additional works at: http://digitalcommons.unl.edu/extensionhist

Part of the Agriculture Commons, and the Curriculum and Instruction Commons

Hodges, Laurie, "NF03-582 Early Season Extentstion Using Hotcaps" (2003). *Historical Materials from University of Nebraska-Lincoln Extension*. 1973.
http://digitalcommons.unl.edu/extensionhist/1973

This Article is brought to you for free and open access by the Extension at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Historical Materials from University of Nebraska-Lincoln Extension by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

University of Nebraska Lincoln

NebFact

IANR

Published by Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln

NF03-582

Early Season Extension Using Hotcaps

By Laurie Hodges, Extension Horticulturist

Hotcaps are covers used to protect individual plants from low temperature stress early in the season. They are usually used by home gardeners or market gardeners with limited production. Growers with more acres or more exten -sive production tend to use row covers or high tunnels that protect more than one plant.

Ideally, a hotcap will transmit sufficient solar energy for photosynthesis and to warm the air inside, but not so much that plants are damaged by overheating. Hotcaps should retain sufficient heat during the night to protect plants from low-temperature injury. They also protect the plant from wind stress early in the season, which can be a significant factor in Nebraska, reducing plant vigor and yields.

Research conducted in 1954 showed that rigid plastic hotcaps provided less frost protection than waxed paper, but that melons started under either system matured at the same rate and produced the same total yield. Production technology has changed a bit since 1954. With new plastics and new product designs, claims are being made for superior heat retention and frost protection.

A study by researchers at Virginia Polytechnic Institute evaluated how three common hotcap designs — opaque plastic milk jugs, waxed paper, and plastic water-filled tubes — affected the growth and development of tomato transplants. Opaque plastic jugs are readily available and inexpensive, even if purchased new. Waxed paper hotcaps are commonly available through garden supply stores and would be considered a "standard" method for protection from spring frosts. Water-filled plastic tubes, such as the Wall-o-Water®, are based on the theory that the water in each tube collects solar heat during the day and then releases it at night. The Virginia study was the first to scientifically investigate the effectiveness of these three methods for frost protection. Microclimate sensors were used to monitor air temperature, relative humidity, and light quantity and quality inside and outside the hotcaps. Tomato transplants were evaluated for vigor, color, height, and yield.

Study Methodology

Four-week old tomato transplants, cv. Early Girl, were transplanted in a field in Blacksburg, Virginia in early April. Standard production practices were used for field preparation. Plants were watered by hand as needed. Three forms of protection were compared: Opaque, plastic one-gallon milk jugs with caps and bottoms removed; plastic, water-filled tubes (Wall-o-Water®); and nine-inch tall waxed paper hotcaps (source: Wetzel Seed Co, Harrisburg, Pa.). Household bleach was added to the water used to fill the plastic tubes to reduce algal growth. The final concentration was a 2.5 percent bleach solution. Waxed paper caps were secured by burying the edges in soil. Plastic jugs were attached with wire to bamboo stakes adjacent to the plants. When the threat of frost was over, plastic jugs were removed, waxed paper hotcaps were slit open on top, and plastic tubes were spread open at the top and narrowed at the base to allow additional room for growth. Excess rainwater accumulating in the hotcaps was not removed. Extensive microclimate data was recorded from each system. Each system also was evaluated in the growth chamber under controlled conditions.

Study Findings

- Plastic jugs could not maintain night air temperatures above ambient and were not effective hotcaps.
- The rate of temperature decline was fastest for plastic jugs and slowest for water-filled plastic tubes.
- Plastic tubes had the highest internal air and soil temperatures.
- The average time to first ripe fruit was reduced by 10.7 days for plastic tubes, 6.7 days for waxed paper hotcaps, and increased by 5 days for plastic jugs compared to uncovered plants.
- Plants grown under hotcaps weighed less and produced fewer fruit on the first cluster compared to the unprotected ("control") plants.

- Plastic tube-style hotcaps moderated daytime and nighttime temperatures more effectively than the other hotcap designs. Periodically ventilating the plastic tubes by spreading the top on warm days may reduce the problem of succulent growth caused by the high humidity and low light intensity. The plastic tubes provided about the same level of protection as plastic row covers used on larger plantings of tomatoes; however, the plastic tubes require a water source to fill them and the process was time consuming. Once filled, plastic tubes were difficult to transport, and the water supported algal growth unless a bleach solution was used (2.5 percent final concentration). It is easier to fill the tubes after they are in place around a transplant by using a hose or portable water source. Although plastic tubes are reusable, they require cleaning between seasons and are expensive (approximately $3.00 each compared to $0.05 for waxed paper hotcaps).
- Waxed paper hotcaps were easy to install and disposable but provided less frost protection than plastic water-filled tubes.
- Plastic jugs are not effective hotcaps because they are difficult to secure in the field, protect only small plants, and do not retain sufficient heat to provide frost protection.

Study Conclusions

In the growth chamber, the rate of temperature decline was fastest for plastic jugs, slightly less for waxed paper hotcaps, and slowest for plastic tubes. All hotcap designs transmitted less than 70 percent of the available solar energy, although plastic tubes transmitted less than either of the other designs. Photosynthetically active light and soil temperatures under sunny conditions were highest inside the plastic jugs. Under cloudy conditions, no design provided warmer soil temperatures than found with no protection. Air temperatures inside the waxed paper hotcaps was as much as 32 degrees warmer than the outside air on a sunny day and almost as high for the plastic tubes and plastic jugs. On cloudy days, internal air temperatures were only three to six degrees warmer. The waxed paper hotcaps provided the highest average increase in air temperature over ambient temperature (21 degrees); however, they did not retain heat best at night, averaging only one degree warmer than the ambient night air. Highest night air temperatures were retained by the plastic tubes, 3.4 degrees above the outside air.

When hotcaps were removed after danger of frost had passed, the plants grown in the hotcaps were tall, succulent, spindly, and had poor color. The control plants (not covered) were shorter at flowering, set more fruit on the first cluster, had higher dry weights and were a darker green than plants grown under hotcaps. The nearly constant high humidity and low light levels under the various hotcaps contributed to the poor plant development. When the first flower cluster develops inside the hotcap, the lack of air movement and excessively high temperatures (greater than 85°F) may result in poor pollination.

From this information, it is evident that two types of commonly used hotcaps provide little or no frost protection and have adverse effects on tomato growth and development. The best option for home gardeners and small-scale market gardeners to protect young transplants from erratic spring temperatures is to use a water-filled plastic tube hotcap, opening it wide on warm days to increase ventilation, reduce humidity, and increase the amount of light reaching the transplant.

Resource

G. E. Welbaum, *Effects of Three Hotcap Designs on Temperature and Tomato Transplant Development*, HortScience 28(9):878-881, 1993.

Note: Reference to commercial products is made with the understanding that no discrimination is intended and no endorsement by University of Nebraska Cooperative Extension is implied.

File under: HORTICULTURE
E-5, Miscellaneous
Issued December 2003

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture.
Elbert C. Dickey, Dean and Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.

University of Nebraska Cooperative Extension educational programs abide with the non-discrimination policies of the University of Nebraska-Lincoln and the United States Department of Agriculture.