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Bulletin 399
September, 1983

Published by the Colorado Greenhouse Growers' Assoc., Inc. in cooperation with Colorado State University

research bulletin

MAJOR ENERGY RESEARCH PROJECT UNDERWAY

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For the first time, a major *SAFE* endowment supported effort is underway this winter to compare infrared radiant heating with a conventional system under comparable conditions. A remote sensing device will be employed to measure plant temperature and control the greenhouse environment.

There has been considerable interest generated in the trade literature on relative advantages of infrared radiant heating in greenhouses. Some commercial establishments have claimed satisfaction with radiant heating, both as to crop response and fuel savings. The European experience seems to be more critical. A number of installations have been made in Colorado. It would be expected that different climatic regions might give variable results.

Last year, the availability of a large commercial sized structure at CSU (Fig. 1) seemed to us an ideal solution for an adequate test of radiant heating versus conventional heating under climatic extremes common to many locations in the continental U.S. Secondly, we felt that conventional control systems for radiant heating might leave much to be desired. We could include a test of remote sensing as a means for better environmental control, especially when a radiant heating system was employed. Through the cooperative efforts of the Combustion Research Corporation of Pontiac Michigan, builder of the "Reflect-O-Ray" infrared radiant heating system, Hewlett-Packard with their latest Automatic Data Acquisition/Control systems and Raytek Incorporated, developer of IR remote sensing equipment, the latest in technology will be united. Grants from SAFE Endowment and Colorado Horticulture Research, Inc. will make this study one of the most timely energy projects to date in the United States.

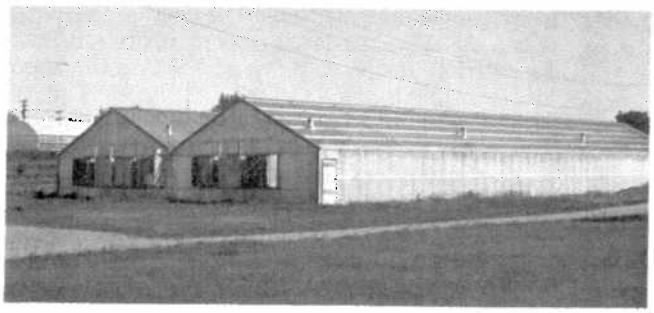

Fig. 1: The 6600 sq.ft. CSU Bay Farm Greenhouse, originally erected in the 1960s, and recovered with FRP Tedlar® in 1980. Orientation is north-south.

Separation between the two ridge-and-furrow greenhouses has been improved by installation of a double-wall (Fig. 2), and radiant heating equipment has been donated, ready for installation in July (Fig. 3). All the old, unit heaters have

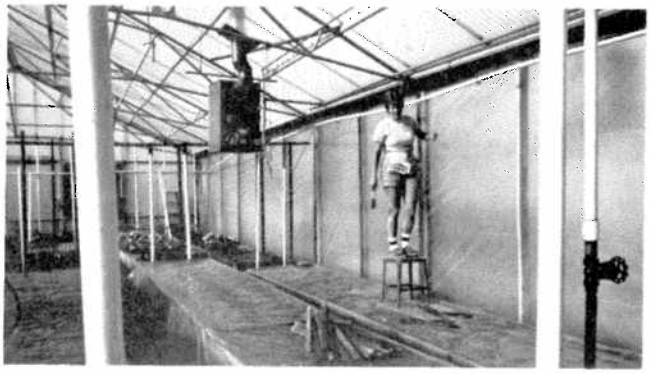

Fig. 2: Undergraduate Connie Smith installing the double, 6 mil polyethylene which separates the two 30x110 ft. houses.

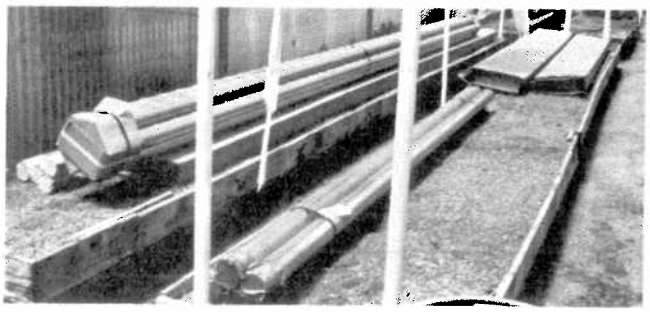

Fig. 3: Infrared radiant heating equipment supplied by Combustion Research and to be installed in the west house.

[1]Professors and Graduate Research Assistant respectively.

been removed (Fig. 4), with the radiant heating in the west house, and two large, gas-fired units in the east house. The inside, opposable, ventilators are separated for independent control, and the pad system has been renovated so pads can be independently controlled in the future. The main experimental crops are carnations (Fig. 5) and calceolaria. The

Fig. 4: Physical Plant employees removing the old, gas fired unit heaters.

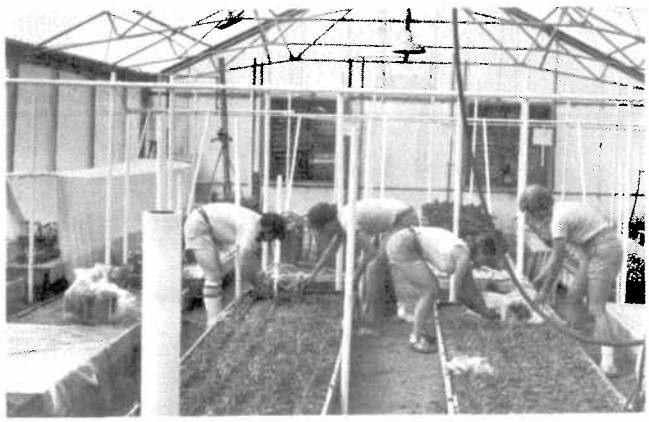

Fig. 5: Graduate students assisting in planting the main experimental carnation crop in June, 1983. This consists of 14, 25-foot, raised benches. Plants are in Idealite and gravel, watered with Chapin double wall tubing.

actual control will be programmed into an HP-85 desk computer (Fig. 6). This represents a first in the use of this Hewlett-Packard equipment for greenhouse environmental control. Another first is the installation of an infrared thermometer to remotely sense plant temperature over a large area (Fig. 7). One of these units will be installed in each house, with the instrument on the west house being used, initially, to control the temperature. There have been publications in the Agronomy literature, suggesting the use of infrared thermometers as a means to schedule irrigation. We will be looking at this possibility, as well as an in-depth examination of internal plant water stress under two heating systems. Crop response under the two heating systems in particularly important.

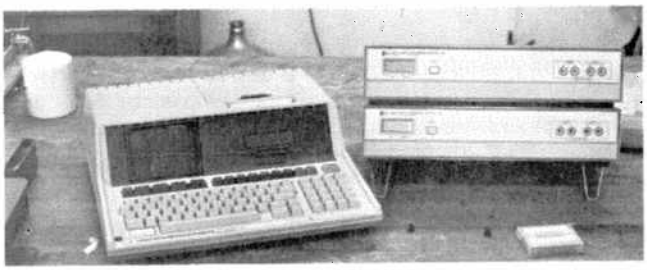

Fig. 6: The HP-85 Desk Computer with two digital acquisition and control units to be programmed for environmental control in the two houses.

Fig. 7: One of the two infrared thermometers for remote plant temperature sensing. The unit in the west house will be used for temperature control. Four aspirated air temperature sensors will be averaged for temperature control in the east house. One of these $2600 units was donated by Raytek, Inc.

Since the construction of the Bay Farm facility in the 1960s, the structure has gone through various modifications. Originally built for carnation breeding and cooling system studies, the facility has been turned into a training area for students. The renovation of the structure for the study this winter has meant a major effort. The data collection system alone will require computer utilization, and the HP-85 provides an excellent addition to our research instrumentation.

This study has received support from several sources, primarily SAFE Endowment and Colorado Horticulture Research, Inc. Additional and significant help has been provided by several organizations, including Hewlett-Packard, Combustion Research Corp., Raytek, Inc., the CSU Physical Plant, and the Colorado Agricultural Experiment Station.