

## Clean-Burning Propane-Fueled Orchard Heaters

### Environmentally Safe Frost and Freeze Protection

Each year, approximately 5 to 15 percent of the world's crops are damaged by cold temperatures. If frost damaged just 10 percent of U.S. apple, pear, and sweet cherry harvests during the year 2000, economic losses could have been as high as \$300 million (**Docket 11116**). Accordingly, the protection of these and other climate-sensitive commodities is a key priority for U.S. fruit producers.

While heating has been employed for centuries as a method of freeze protection, traditional heaters are difficult to use and can lose up to 85 percent of the heat produced due to radiation into the earth and sky known as the "stack effect." Propane's high heat content and the heater's unique design enable a greater percentage of heat to radiate directly into the crop, thus increasing the efficiency of crop protection (see sidebar).

Propane provides a clean-burning and efficient option for orchard heating compared to diesel-fueled heaters. In contrast to diesel spills that pose a significant risk to surrounding orchard trees by contaminating water and soil, propane vaporizes into the air and is nontoxic and insoluble in water, eliminating any risk of soil or water contamination.

The AgHeat propane heater is a new technology that provides powerful heat with a small environmental footprint. It is of particular interest to orchards, vineyards, and many other small fruit and vegetable crops in temperate areas like the Pacific Northwest.

### Project Description

The *Environmentally Safe Orchard Heating for Frost and Freeze (Docket 11116)* study, funded by the Propane Education and Research Council (PERC) and performed by Oregon State University, was conducted to evaluate the heat and smoke released by three types of frost protection systems currently used in the northwestern U.S. These systems included AgHeat propane heaters, shell casing propane heaters, and diesel-burning smudge pot heaters. The project's goal was to provide orchard owners and operators with scientific data to help guide system comparison and selection.

This study demonstrates the propane industry's commitment to bringing efficient and innovative uses of propane to farmers and producers to help them increase productivity, reliability, and environmental friendliness.

### Innovative Design Provides Powerful Heat

The pyramid shape of the AgHeat heater allows more heat to be directed to the air surrounding the crop than vertical pipe designs. Unlike traditional burners that convey hot gases upward, the patented propane burner creates thermal turbulence to push the heat down and out, retaining the warmed air in the crop zone.





### The AgHeat Propane Heating System

The 2.25 acre orchard heating installation included the following:

- Pyramid burners placed every three trees in every other row
- Two 1,000-gallon propane tanks
- Two propane vaporizers
- Underground piping, sub-main, and main propane distribution system
- Orchard fan

### Project Implementation

The study evaluated three different frost protection systems during the spring season, including AgHeat propane heaters, shell casing propane heaters, and diesel-burning smudge pot heaters. Laboratory and in-field testing monitored and recorded the following data for each type of heater:

- Heat release rates
- Smoke emissions rates
- Fuel consumption rates
- Average temperature increases

In-field tests were performed with each type of heater on a rotating basis in both 2005 and 2006. Testing equipment recorded data every five minutes and included 30 temperature-monitoring systems placed throughout the orchard as well as a weather station tower that monitored wind speed and direction, dry-bulb temperature, and relative humidity.

### Key Conclusions

The test results demonstrate that propane is the cleaner and more efficient fuel for the orchard heaters. Other key findings include:

- AgHeat propane heaters provided the greatest temperature rise on less fuel.
- AgHeat propane heaters produced the least smoke emissions.
- AgHeat propane heaters produced the largest average increase in temperature at the 4', 8', 12', and 16' recording levels.
- Diesel heaters produced the most smoke emissions, between three and four times the amount of smoke released from the propane heaters.

### Operational Benefits of AgHeat Propane Heaters

Propane-fueled orchard heaters offer major operational benefits over diesel-fueled heaters:

- **Ease of use**—Propane gas flow rates were controlled by a single pressure regulator.
- **Reduced ignition time**—Propane burners required one hour compared to two hours for diesel burners, which must have the air-vent adjusted by hand to achieve the proper setting.
- **Reduced shut-off time**—Closing the valves to the sub-main supply lines for the propane burners only took five minutes, while diesel burners required one hour to extinguish the flame of each heater.



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