

# FROST PROTECTION FOR YUMACITRUS

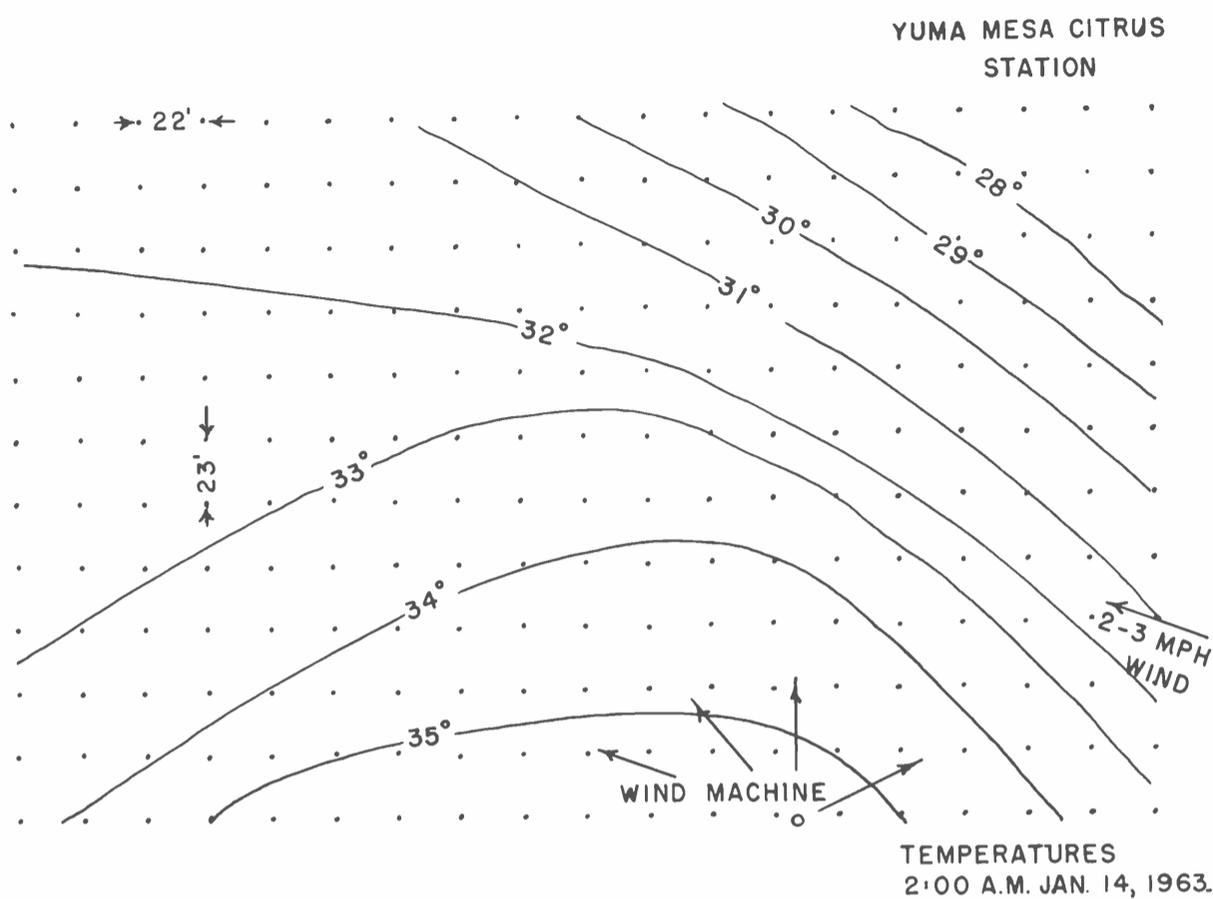


FIGURE 1 — Temperatures five feet above ground level several hours after wind machine was started. Inversion temperature was about 8° (40 foot temperature — five foot temperature).

By K. R. Frost

During several recent winters there have been opportunities to conduct evaluation trials of several methods of frost protection in citrus on the U. of A. Yuma Mesa Station. These evaluations have been cooperative between Agricultural Engineering and Dr. D. R. Rodney of the Horticulture Department. Frost protection methods

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included in these trials are wind machines, sprinkler irrigation, propane burners and wax candles.

Engine-driven wind machines were installed at the station in the fall of 1962. A tower upon which are mounted thermocouples for temperature measurement at several elevations, and a temperature recorder, are available for determination of vertical distribution of temperature.

## Keep Temperature Records

The general technique of all evaluation trials has been to maintain a record of temperatures within the outside of an area to be treated with a frost protection method. Several hours of such records establish a temperature relationship between the treatment area and the non-treatment area. After this relationship is established, temperature control treatment (starting of wind-machine, lighting burners, etc.) is initiated. Temperatures continue to be observed. Changes in the temperature relationship between the treated and untreated area are an indication of the effectiveness of the temperature control treatment.

On the night of January 13-14, 1963, a minimum temperature of 27° F. was forecast at a low-wind velocity. Thermometers were placed at various distances up to 300 feet from the wind machine. Temperatures were also recorded outside of the area influenced by the draft of the propeller. The wind was 2 to 3 m.p.h from an easterly direction. Areas near the wind machine were 5° to 8° higher in temperature than temperatures recorded outside the test area.

Three hundred feet northwest of the wind machine the temperature at 2:00 a.m. (4 hours after machine was started) was 4 to 5 degrees warmer than in unaffected areas. (See Figure 1). The temperature inversion (temperature 50 feet above ground minus temperature 5 feet above the ground) at this time was 8° F. and

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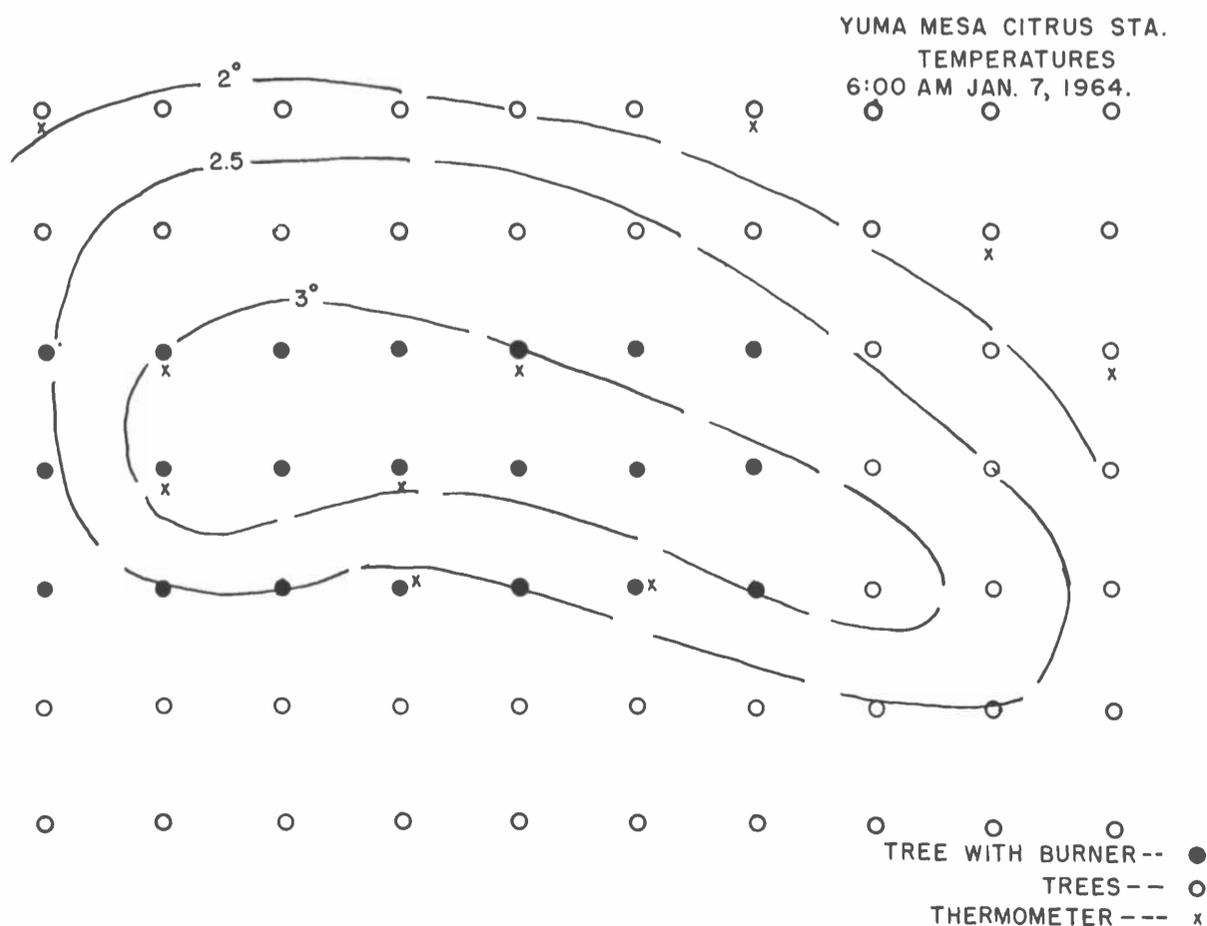


FIGURE 2 — Increase in temperature caused by propane burners under 21 trees, average temperature in the unheated area at five foot level.

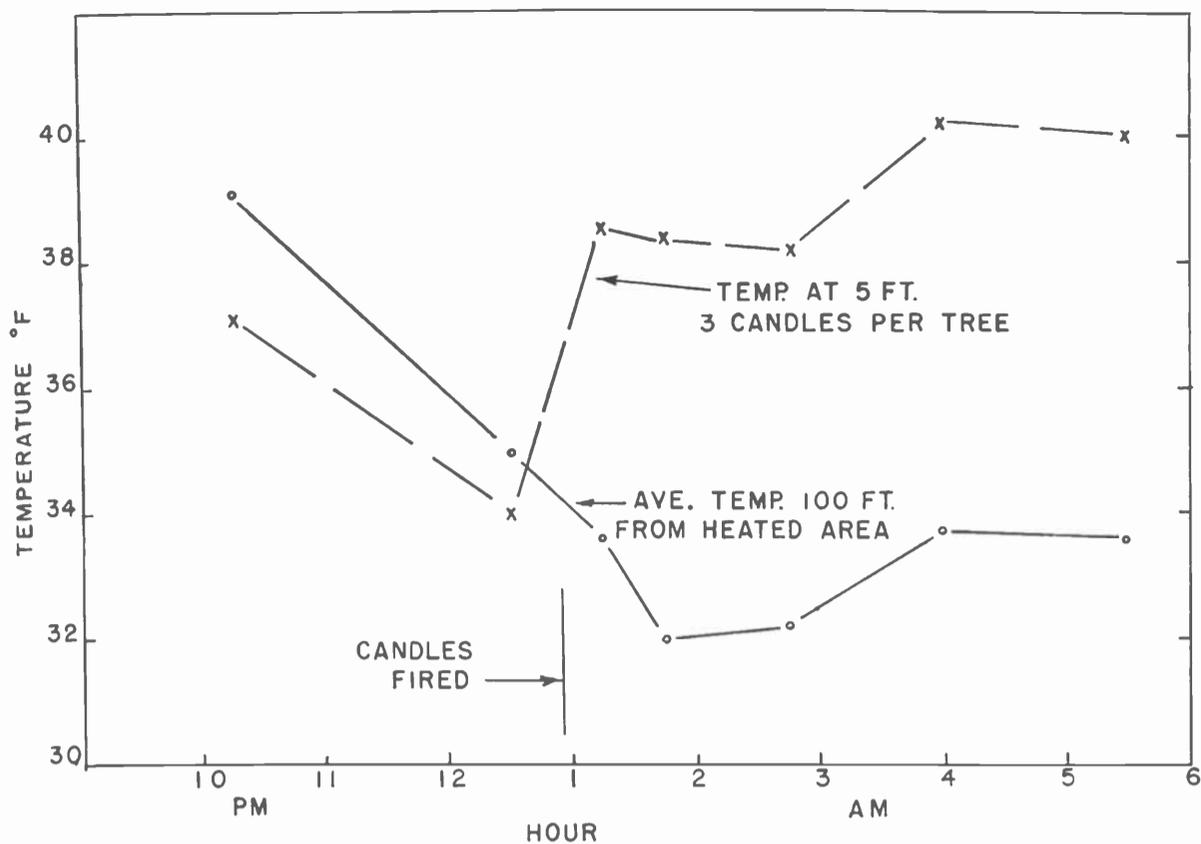


FIGURE 3 — Effect of three lighted wax candles per tree placed between trees on temperature of 64 Valencia orange trees at five foot above ground level, Jan. 25-26, 1965.

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about average for the Yuma Mesa. These results indicate that temperature on the Yuma Mesa can be increased 6° to 8° F. by adequate equipment (50 H.P. machine for 10 acres) when inversion is 8° F. or more.

#### Some Burner Damage

Propane burners designed especially for connection to permanent sprinkler system lines were installed in a block of 21 trees in the fall of 1963. On the night of January 6-7, 1964, the temperature dropped to 32° F. and burners were fired at 3:00 a.m. There was a slight wind blowing from the east at that hour.

Although the burners were placed 8 inches from the ground and directed a few degrees away from the tree trunk there were a few leaves burned. Temperatures were taken at the 5 foot level in the trees as indicated in Figure 2. At 6:00 a.m. the temperature was 2° to 3° higher in the heated area than in the surrounding unheated area. With a 3-hour test the burners consumed 40 gallons of propane. The temperature increase would no doubt be higher if a 5-to 10-acre tract could be heated, for the small area under test was influenced greatly by the surrounding unheated area.

#### Wax Candles Tried

The petroleum industry has introduced a wax candle for orchard pro-

tection. The candles tested weighed 14 lbs. and were provided with fiberglass or perlite wicks. Candles burn for 12 to 14 hours and furnish 125,000 B.T.U. of available heat.

In the first test candles were placed one under each tree. The rise in temperature was noticeable but not sufficient for protection. It was difficult to get candles under the tree overhang and some trouble was encountered in lighting.

In a second test two candles per tree in under-tree locations were used in one treatment and two candles per tree in between-tree locations were used in another treatment. The location of candle placement had no influence on the temperature rise. Both two candle-per tree treatments gave a four degree temperature rise. A third test was made on January 25-26, 1965, with three candles per tree placed between trees in a square block of 64 trees. Very little if any wind was blowing during this test. A temperature rise of 6° F. was noted during most of the night after candles were fired (Figure 3).

#### Sprinkler Irrigation Used

In January of 1963, three sprinkler lines were operated with low-angle sprinklers to determine their effect on temperatures during cold periods. The temperatures were lowered rather than increased when the sprinklers were operated on a windy night. The following night with no wind the tem-

## Mystery Picture Plant? Coffee Tree, Of Course!

That mystery plant, pictured on Page 7, is a small coffee tree growing in the horticulture greenhouse at this university's Campbell Ave. farm in Tucson. Prof. William Bemis, who experiments with many strange plants out there, pointed out this little greenhouse tree to us last June, when the tiny white blossom clusters were most attractive.

## Agricultural Plastics Conference in Phoenix

Greenhouses and mulching will get special attention at a meeting of agricultural leaders which will turn the national spotlight on Arizona in November.

Other agricultural uses of plastics will be reviewed, too.

The meeting will be the Sixth Annual Plastics Conference scheduled for Nov. 16, 17, and 18 at the Ramada Inn at Phoenix. Agricultural plastics experts from all over the nation will attend.

Activities will include tours, talks, meetings and discussions centering on the uses of plastics in agriculture. Greenhouses and mulching will be given special attention. A tour of central Arizona agriculture will be taken the first day.

perature at 5-ft. level was 1° to 2° F. higher during the sprinkling period in the sprinkled area than in the non-irrigated area.

In summary, we learned that:

1. Wind-machines will increase temperatures at the 5-ft. level by 5° to 8° F. if the inversion is 8° F. or more.
2. Propane burners installed on permanent sprinkler lines will give protection up to 3° and possibly more if one burner per tree is used on a tract of 5 to 10 acres.
3. Wax candles are satisfactory for orchard protection if three per tree are provided. Probably they should be considered for special or emergency conditions as around yards, nurseries or young tree orchards.
4. Sprinklers are a useful orchard protection to the extent of several degrees. Ice formation must be prevented by high application rates if overhead sprinkling is used on mature trees or trees will break from the weight of the ice.