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USE OF LOW-VOLUME SPRINKLERS FOR FROST PROTECTION OF BLUEBERRIES

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INTRODUCTION

In recent years there has been substantial fruit loss due to late spring frost and freezes. Overhead sprinkler irrigation is the traditional method of frost protection for many crops. Although this system works well it can be a costly investment, both in dollars and in the amount of water needed to operate the system for either small or very large operations. In 1989, we began looking at alternative frost protection methods. One of these methods included the use of low-volume sprinklers mounted either above the plant or within the canopy of the plant. This system has an advantage in that it could be less expensive to install or adapted to existing drip irrigation systems and use less water than conventional overhead irrigation systems.

MATERIALS AND METHODS

Preliminary data were collected to evaluate the influence of low-volume sprinklers on temperatures within the canopy of mature 'Tifblue' rabbiteye plants during a frost. Treatments installed were: 1) a 360° low-volume spray emitter (LVSE) placed 3 feet above the plant canopy, 2) a 40° LVSE placed 3 feet above the plant canopy, 3) a 360° LVSE placed 1 foot above the ground, 4) a 20° LVSE placed 3 feet above the ground with the spray directed upward into the canopy of the plant. The frost protection systems were turned on at 10 pm and turned off at 8:30 am the following morning. Temperatures were monitored at several locations within the canopy of the plant every 15 minutes from 10 pm until 11 am using a multipoint recorder. The pattern of ice formation throughout the canopy and the color of the ice were also recorded.

RESULTS AND DISCUSSION

Only 2 treatments provided adequate frost protection. The 360° low-volume sprinkler mounted 3 feet above the plant canopy afforded protection, however, one sprinkler might be insufficient for complete coverage. Instead, 100% overlap would be required to assure complete canopy protection. With this amount of coverage, the

entire orchard would be covered and result in less water savings. The upward spraying 20° sprinkler installed within the canopy of the plant also provided frost protection. In this treatment, a complete cone of ice was formed within the canopy of the plant. This cone had a radius of 1.5 feet and extended 2 to 3 feet above the emitter. The height of the canopy still being wetted the following morning was limited by the cone of ice that formed above the emitter, blocking the spray height to 1 to 2 feet. The important aspect of this method is that it provided ice coverage where it was needed within the plant, not across the entire orchard floor. It also used the least amount of water (4-5 gph/emitter/plant) and the emitter can be easily redirected for irrigation use.

Installing 360° spray emitters 1 foot above the ground failed to provide any real protection. If the entire orchard floor had been covered, rather than a few plants, some modification in temperature would have been apparent due to the effect of the mist trapping reradiated ground heat. If the entire orchard were to be covered this would not be the most effective use of water. The 40° emitter did not provide adequate water coverage to provide frost protection.

Figure 1 indicates the temperatures for several locations during the night. These temperatures were taken at the 4 to 5 foot level within the canopy. Several things should be noted. First, good ice coverage, as indicated by temperatures within the area covered by the 360° and 20° low-volume sprinklers, provided excellent temperature control. Second, poor water coverage resulted in the formation of milky colored ice. This milky ice did not maintain the canopy temperature above freezing. Good water coverage is mandatory for the formation of clear ice and for maintaining temperatures above freezing. Third, turning off the sprinkler before complete ice melting resulted in a temperature drop of several degrees below zero. This is a critical issue with any type frost protection utilizing water for ice formation. If the water is turned off too soon more plant damage can occur than would have been caused by the frost itself.

This study was preliminary and more data will be needed to determine effect on reducing frost damage and the cost effectiveness compared to conventional overhead sprinklers. The use of 20° sprinklers within the canopy appears to be a practical and efficient method of frost protection and warrants further investigation.

Air Temperatures During Frost

