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NON-WOVEN POLYPROPYLENE FABRIC ROW COVER FOR FREEZE PROTECTION IN BLUEBERRIES

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Abstract. **Periodic late-season freezes have caused major damage to blueberry fruit and flowers in Florida. Row covers with and without microsprinkler irrigation were tested as a means of crop protection. The three treatments consisting of uncovered control, row covers, and row covers with microsprinkler irrigation were randomly assigned to six 14-plant plots of 3-year-old blueberry bushes at the Horticultural Unit in Gainesville, FL. Covered plots were completely enclosed under non-woven polypropylene fabric (3.1 oz per square yard) which was supported above the plants on wire trellises and anchored to the ground with wire ground staples. Covers were put in place the afternoon before each trial and removed the following morning. Each microsprinkler plot contained eleven sprinklers (10 gal/hr each @ 20 psi) spaced 5 ft. apart under the bushes. Temperature data were recorded hourly from three thermocouples placed within the canopies in each plot on the nights of 5.6 Feb., 20-21 March and 21-22 March 1990. The coldest temperatures recorded during the trial were 28°F with heavy frost on the morning of March 21. Temperatures of 28° with some damage to fruit and flowers occurred in both covered and uncovered plots without microsprinklers. Throughout the trial, temperatures in covered plots without microsprinklers did not differ significantly from uncovered plots, but covered plots with microsprinkler irrigation were 8-12°F warmer.**

Post bloom freezes are a perennial threat to blueberry production. The problem is magnified in Florida where warm January temperatures often stimulate bud-break in early season cultivars two months or more before the danger of killing freezes is passed. Many of Florida's commercial blueberry growers have installed permanent overhead irrigation systems with frost protection capabilities on at least part of their acreage.

There are many drawbacks associated with overhead irrigation for freeze protection. An overhead system must have adequate water supply and pumping capacity to deliver at least 0.15, and preferably 0.25 inches per hour without interruption for the duration of a freeze (2). Wells and pumps must greatly exceed the size that would be suitable for normal irrigation when smaller sections can be rotated. The inability of overhead irrigation to protect flowers and fruit through severe, windy freezes is another drawback that was demonstrated when much of Florida's 1989 crop was lost on 24 Feb. During this freeze, some growers felt that irrigation did more harm than good as bushes were broken down from excessive ice build-up, and temperatures fell below critical levels despite the water. Equipment failure such as pump breakdowns, power-outages and pipeline blow-outs have also plagued growers in their freeze protection endeavors with overhead irrigation. In these situations, where water supply is inadequate or interrupted, evaporative cooling of wetted plants can cause more damage than if no protection had been attempted. Excessive moisture on and around the plants following a freeze may promote the growth of fungal pathogens during the vulnerable flowering and early fruit development stages. Above all, Florida's diminishing groundwater supplies demand the investigation of freeze protection methods requiring less water.

Non-woven polypropylene fabric row covers have been tested and used successfully for frost protection of strawberries in Florida (3). In these experiments a 2 oz/yd fabric laid directly over the strawberry beds maintained temperatures in the crown area at 32°F while unprotected crown temperatures dropped to 17°F. Lightweight row covers have also been used over warm season vegetables in colder climates (4). Although these have been used primarily for growth enhancement through increased daytime temperatures, 3-5°F of frost protection have also been reported in these studies.

In general, successful frost protection with polypropylene fabric has been limited to low-growing crops where heat from the ground can be partially trapped. The flowers and fruit of mature blueberry bushes may be 7 ft. above the ground, thus requiring that a much greater volume of space be protected from the same area of heat source. For this reason row covers were tested both alone and with the added heat source of under-bush microsprinkler irrigation. Microsprinklers operating in enclosed space were observed to provide 8-10°F increase in temper-

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ature in Gainesville, FL during the severe winter freeze of 1989 (F. S. Davies, personal communication).

Materials and Methods

The trial was conducted at the Horticultural Unit, Gainesville, FL, on six fourteen-plant plots of 3-year-old blueberry bushes that had been previously mulched with pine bark. Three treatments: uncovered, covered, and covered with microsprinkler irrigation were randomly assigned to two plots each. Wire trellises were erected to suspend the fabric above the covered plots to avoid direct contact between the fabric and plants. The irrigated plots contained eleven (10 gal/hr @ 29 psi) Danjet 360° deflector-type microsprinklers placed about 5 ft. apart beneath the bushes. Their wetting patterns were adjusted to cover a 3 ft. diameter circle with minimal wetting of the plant's lower branches.

The fabric tested was Amoco Fabrics, Inc., Atlanta, GA product no. 4741 needle-punched, non-woven polypropylene, 3.1 oz per square yd. Strips of fabric, sixteen feet wide, were draped over the trellises of the covered plots and anchored to the ground on each side with wire ground staples, thus enclosing individual plant rows. The ends of the covered plots were closed with separate pieces of fabric. The row covers were put in place on the afternoons preceding anticipated frost events and removed the following morning.

Temperatures were recorded hourly on a Leeds and Northrup Speedomax model 250 multipoint recorder from three thermocouples in each plot. Thermocouples were placed about 2 ft. above the ground near the center of the bush canopies and well above the microsprinkler spray patterns in the irrigated plots.

Results and Discussion

Temperature data were collected on the nights of 5-6 Feb., 2-21 March and 21-22 March 1990. Only on the night of 20-21 March were temperatures sufficiently low to inflict damage on unprotected plots. Sheltered air temperatures were below 32°F for about 6 hr., with a minimum temperature of 28°F for about 3 hr. Heavy frost accumulated on the ground and on the fruit, flowers and leaves of unprotected plants.

No appreciable temperature differences were observed among the treatments until the microsprinkler irrigation was activated at 10:48 pm (Fig. 1). Within the hour temperatures in the covered plots with irrigation increased from 36°F to 42°F and remained 8-11°F warmer than the controls or the covered plots until after sunrise. Although visible frost accumulation was lighter on the non-irrigated covered plots than on the uncovered plots, freeze damage to fruit and flowers occurred in all non-irrigated plots. The six thermocouple locations within each treatment varied less than 2°F from their mean at any hourly reading.

Sheltered air temperatures remained slightly above 32°F on the nights of 5-6 Feb. and 21-22 March. Temperatures in the covered plots were similar or identical to the uncovered plots while covered plots with irrigation were 8-12°F warmer (data not shown).

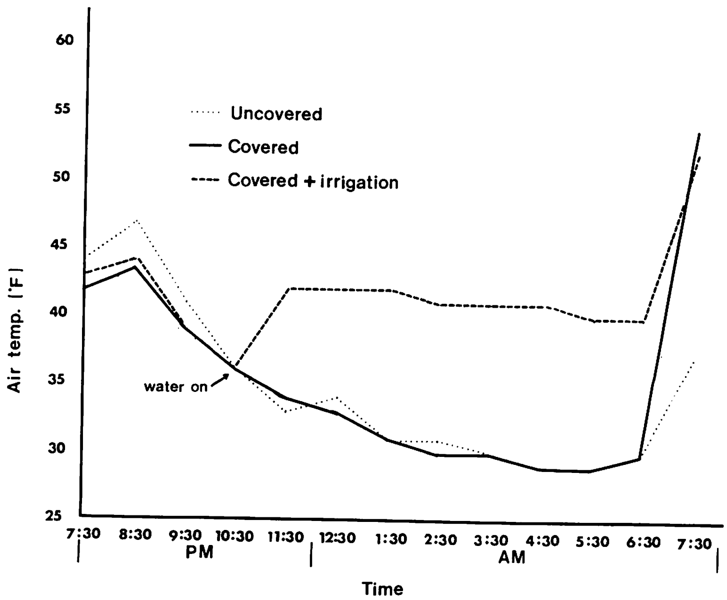

Fig. 1. Effects of row covers with and without microsprinkler irrigation on air temperatures surrounding 3-year-old blueberry bushes, 20-21 March 1990. Temperatures at each hour are means of 6 measurements. Temperatures varied 2°F or less from the mean for any given time.

These preliminary tests showed clearly that non-woven polypropylene fabric row covers alone will not provide freeze protection for blueberries when erected over single rows. The combination of row covers and microsprinkler irrigation, however, could prevent losses from most late season freezes in Florida.

The 5 ft. spacing of microsprinklers was intended to wet the entire soil surface beneath the canopy of the bushes as would be desirable for normal irrigation. At this spacing the density of microsprinklers would exceed 500 per acre, and the amount of water required to run them all simultaneously would be similar to running overhead irrigation. Freeze protection with row covers, however, can probably be accomplished with a much lower rate of microsprinkler irrigation than was used in this experiment. Further studies would be necessary to determine the minimum amount of irrigation required to maintain safe temperatures under the covers.

From a practical standpoint, the expense and labor required to cover and uncover large acreages of blueberries will probably restrict the use of row covers to ultra high density plantings. The increased per-acre value and expense of such plantings may justify the extra cost for reliable frost protection.

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