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Early Planting of Tomatoes in a High Tunnel with Plant Coverings

Abstract

High tunnels have been successfully used in Iowa to modify the climate and extend the growing season for tomatoes and other crops. Without the use of supplemental heat these ventilated, single layered plastic structures have typically increased average inside air temperatures by 10°F or more over outside temperatures for the growing season. The same tunnel, however, will only increase the daily low temperature by about 1 or 2°F, thus making early season high tunnel plantings without additional heat or plant coverings risky in Iowa. Fabric row covers are commonly used in high tunnels to provide for an additional 2-4°F frost protection during cold evenings. The recommended planting date for high tunnel tomatoes in Iowa has been about April 16 (4 to 5 weeks ahead of the recommended outside planting date). Producers are also advised to have some sort of plant covering material available to protect plants during a late spring frost.

Keywords

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Disciplines

Agricultural Science | Agriculture

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Introduction

High tunnels have been successfully used in Iowa to modify the climate and extend the growing season for tomatoes and other crops. Without the use of supplemental heat these ventilated, single layered plastic structures have typically increased average inside air temperatures by 10°F or more over outside temperatures for the growing season. The same tunnel, however, will only increase the daily low temperature by about 1 or 2°F, thus making early season high tunnel plantings without additional heat or plant coverings risky in Iowa. Fabric row covers are commonly used in high tunnels to provide for an additional 2-4°F frost protection during cold evenings. The recommended planting date for high tunnel tomatoes in Iowa has been about April 16 (4 to 5 weeks ahead of the recommended outside planting date). Producers are also advised to have some sort of plant covering material available to protect plants during a late spring frost.

Materials and Methods

Producers with high tunnels have sought low cost methods of climate modification in their tunnels. This would allow them to plant earlier and hopefully increase harvest earliness to gain a market advantage. The project was established in a 30 ft × 96 ft high tunnel at the Armstrong Research Farm to help manage the risk of a late March tomato planting date. The focus of the project was to evaluate three simple and low cost temperature modification practices on tomato transplants set in the tunnel three weeks ahead of the recommended or ideal planting date.

The passive plant protection treatments selected included a 2-oz poly fabric row covering (Agribon), a 1-oz poly fabric row covering plus water filled black milk jugs between each plant, and a water filled plant protector (Wall O'Water). Five-week-old Rocky Top tomato transplants were set 18-in. in row and 4.5 ft on center in the tunnel on March 28 and the three plant protection treatments were applied and remained for three weeks. A second planting of the same cultivar was made on the recommended date of April 16 without any plant coverings to serve as a control. Data loggers were installed in each of the treatments to measure any air temperature differences. After the removal of the treatments all plants were staked and pruned to a single flower cluster. Irrigation scheduling was via tensiometers. Recommended cultural practices for plastic mulch, fertilization and pest management in high tunnel tomato production were followed. Data collected for the project included air temperatures within each treatment, harvest dates, and yield. The plants were harvested twice weekly and sorted into marketable fruit and culls prior to weighing.

Results and Discussion

Average daily high and low temperatures base 50 growing degree units, as well as the average outside air temperatures for each treatment are presented in Table 1. Outside air temperatures fell below freezing on three nights after the March 28 planting but no freezing temperatures were recorded after the April 16 planting date. Each of the three plant coverings provided adequate frost protection for the early planting date. Plants not only were protected but seemed to thrive under the coverings. When the plant covers were

removed after three weeks (April 18) plant height measurements were taken prior to plant staking. The plants in the Wall O'Water treatment averaged 16 in. tall while both the fabric and fabric plus water filled milk jug treatments averaged 14.5 in. tall. Several plants had flower clusters present in each treatment when the coverings were removed and plants appeared to be healthy and vigorous. Air temperature inside the tunnel (control) averaged 22°F warmer than the outside temperature for the 3-week period (March 28–April 18). Interestingly, the average daily temperatures under each of the plant protective treatments were cooler than the uncovered treatment (control). It is important to note that these same plant coverings raised the average daily low temperature and lowered the daily high temperature. These treatments appeared to have a “buffering” effect on temperatures thus keeping these plants in a favorable growing temperature (50-86°F) for a longer period of the day. This buffering effect was more evident in the Wall O'Water and Agribon + milk jug treatments. These plant protectant devices utilize water capable of capturing solar heat during the day and releasing it at night. Base 50 growing degree units are also presented in Table 1 to show this effect.

Overall yields in the study were excellent and the goal of producing a crop of marketable tomatoes by July 1 in Iowa was achieved. Each of the three plant covering treatments increased early season yields as well as total yield. Early season yield increases of 7 to 12 lb/plant were recorded over the uncovered treatment planted at the recommended date. The 2 percent Agribon poly fabric row cover treatment produced the highest early fruit yield. Yield increases for the covered treatments over the entire 10-week harvest period averaged from 11 to 22 lb/plant. The Wall O'Water treatment showed the greatest total yield increase. Based on this one year study it appears that simple, low-cost passive climate controlling row covers can provide both frost protection and growing conditions suitable for early planted tomatoes. It should be noted that the early spring temperatures in 2010 were not excessively cold and more testing under colder temperatures would be needed prior to making any recommendations.

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Table 1. Average daily air temperatures (°F) under plant protective covers.

| Treatment | Daily Average | Daily Average | Daily Average | Base |
|----------------------|------------------|-----------------|---------------|------------|
| | High Temperature | Low Temperature | Temperature | 50 GDUs |
| Control ¹ | 106.6 | 50.0 | 78.3 | 464 |
| Wall O'Water | 92.8 | 53.6 | 73.2 | 482 |
| Agribon fabric | 102.1 | 51.5 | 76.8 | 474 |
| Agribon + milk jugs | 92.7 | 52.7 | 72.7 | 475 |
| Outside tunnel | 68.1 | 45.2 | 56.7 | 243 |

¹Control temperature was measured on plastic mulch with no plant covering.

Table 2. Early¹ and total² season yield (lb/plant) of tomatoes in high tunnel.

| Treatment | Early yield ¹ | | | Total yield ² | | |
|--------------------|--------------------------|-------|-------|--------------------------|-------|-------|
| | Mktable | Total | Cull% | Mktable | Total | Cull% |
| Control | 34.3 | 39.7 | 15.7 | 58.8 | 70.0 | 19.1 |
| Wall O'Water | 44.5 | 54.2 | 21.9 | 80.9 | 100.5 | 24.2 |
| Agribon fabric | 46.2 | 55.1 | 19.2 | 74.5 | 89.5 | 20.1 |
| Agribon +milk jugs | 41.4 | 52.6 | 26.9 | 69.3 | 87.2 | 25.8 |

¹Early yield equals the first three weeks of harvest expressed in pounds.

²Total yield equals the first 10 weeks of harvest expressed in pounds.