Objective 1. Determine the temperature moderating effects of low tunnels constructed of various materials in a range of New England climates

Our Methods: Six (6) sites were selected to span the growing regions of the cooperating states to include Northern, Central, Southern, and Coastal sites. In New Hampshire, the three sites were: Blue Ox Farm, Enfield NH (USDA hardiness zone 4b); Picnic Rock Farm, Meredith NH (zone 5b/5a), and Woodman Horticultural Research Farm, Durham NH (zone 5b).

Low Tunnel Details: At each site, we installed three different types of low tunnels with different types of coverings. Tunnels were supported by 10' lengths of plastic PVC spaced 2.5 feet apart. Each test low tunnel was 40' long x 5' wide (200 sq ft). Orientation of tunnels varied depending on the farmer cooperator's site, but shade was avoided. Three tunnel coverings were selected based on the results of pilot experiments (conducted in Winter 2010): Rowcover – 2 layers , Rowcover PLUS Greenhouse plastic, Rowcover PLUS Perforated plastic. At each site, an uncovered control was included. Rowcover = heavyweight rowcover recommended for overwintering (Dupont 5131, 1.25 oz/sq yd, 70% light transmission, Autoverters Inc.). Plastic = 6 mil IR greenhouse covering, Perforated plastic= 2 mil perforated plastic row cover (Dubois Agrinovation).

Data Collection: In each tunnel and outdoors adjacent to the tunnels, a Hobo UA-002-08 (Onset Computer Corporation) pendant data logger was used to record temperature and relative light levels every 2 hours throughout the winter. It is important to note that the temperatures measured by these loggers are not reliable if they are not properly shielded from solar radiation. During this experiment, inverted fiber berry boxes were used to shield the loggers.

Conclusions from the First Year of Low Tunnel Data – New Hampshire

Over the next pages, you will see three 5-6 day snapshots in time during the 2010-11 winter. Each page compares the low tunnel temperatures observed in the three NH sites. For each, observations are discussed.

Time period 1. December 10-15, 2010.

This time period included a mixture of sunny and cloudy, but typically cool, December days. On sunny days and in nights between sunny days, low tunnels made with all three coverings were warmer than the outdoor temperature. In general, temperatures followed the following pattern:

rowcover plus plastic > rowcover plus perforated plastic > 2 layers rowcover > outdoors

In other experiments, we have consistently seen that plant survival and early spring growth under different coverings follows a similar pattern; the greatest survival and growth is seen under low tunnels covered with rowcover plus greenhouse plastic.

On the two cloudy days, however, the outdoor temperatures were consistently (in all three locations) a few degrees higher than the temperatures measured in the low tunnels, regardless of covering. The mechanism for this isn't clear, but there is some published work that may shed light on what's going on.

Time period 2. January 15-20, 2011.

This six-day period was had typical January temperatures, starting with three sunny days and then a snowstorm than buried the tunnels in Enfield and Meredith sites. In Durham, while snow temporarily covered the tunnels during the snow storm, preventing temperature fluctuations from solar gain, regular daily fluctuations resumed after the snow was done. In Meredith, all three tunnels were buried with snow, but the outdoor probe was not buried. In Enfield, all probes were buried. As a result, the temperatures in all buried probes were relatively similar, showing the insulating properties of snow – which is even more evident in Time period 3.

Time period 3. January 22-26, 2011.

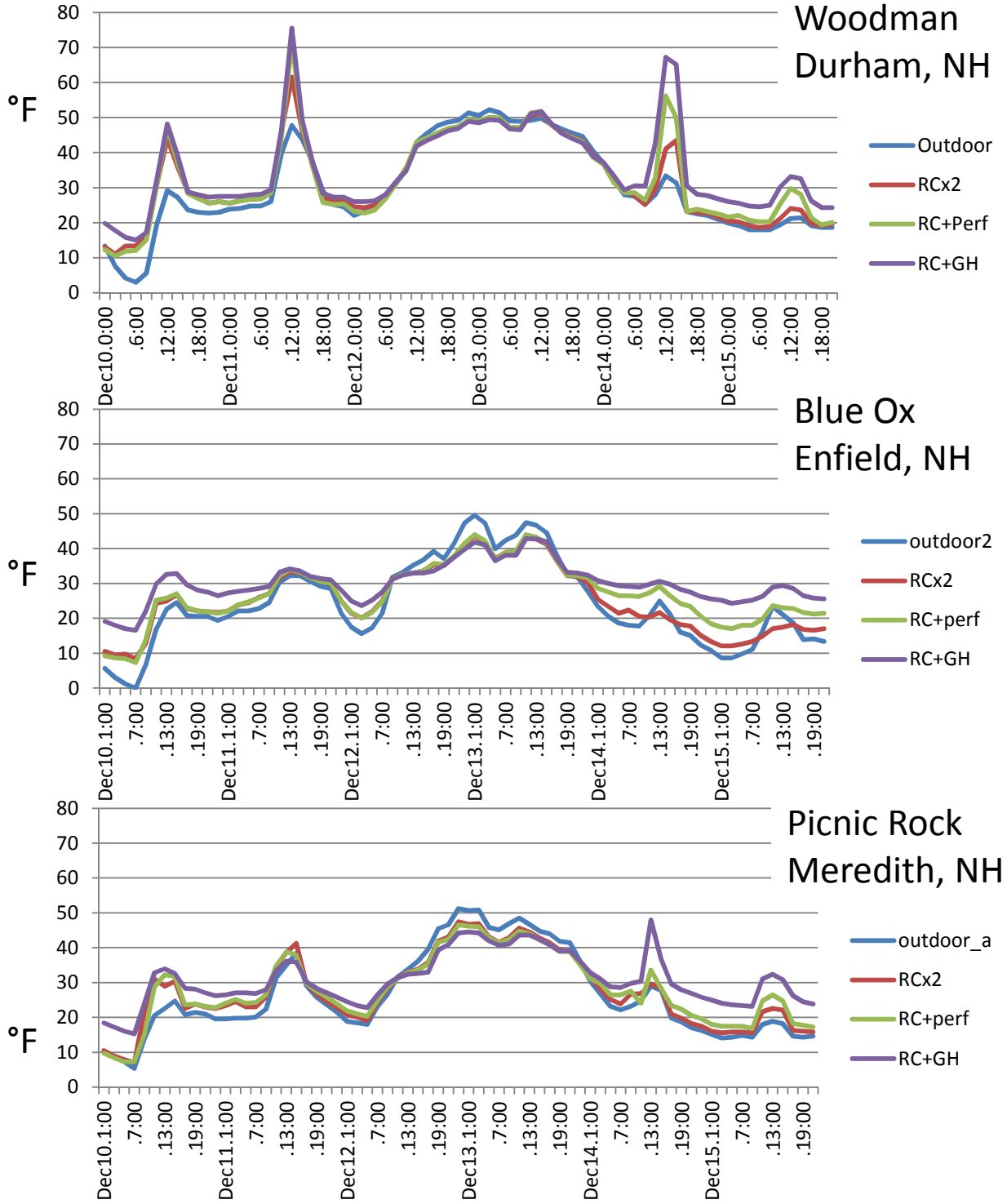
This 5-day period spanned the coldest night of 2011, which occurred on January 24. The tunnels in Meredith and Enfield were still covered with snow. Because the outdoor probe in Enfield was also covered with snow, we do not have a valid outdoor temperature for comparison. (Nearby weather stations had low temperatures on that date of -18F, -21F, and -28F).

These graphs confirm the excellent insulating properties of snow. While outdoor temperatures approached an estimated -20F in Enfield, probes under snow and in tunnels under snow measured 14-25F. In Meredith, probes under snow measured 18-28F, compared with -14.4F outdoors.

Low tunnels do provide some insulating properties as well. The Durham data show that, when outdoor temperatures reached -12F, the rowcover + greenhouse plastic tunnel hit a low temperature of 13F. Tunnels covered with the other coverings were considerably colder (0F, -7F).

December 10 through December 15, 2010

Mixture of sunny (12/10-11, 12/14-15) and cloudy/raining (12/12-13) days.

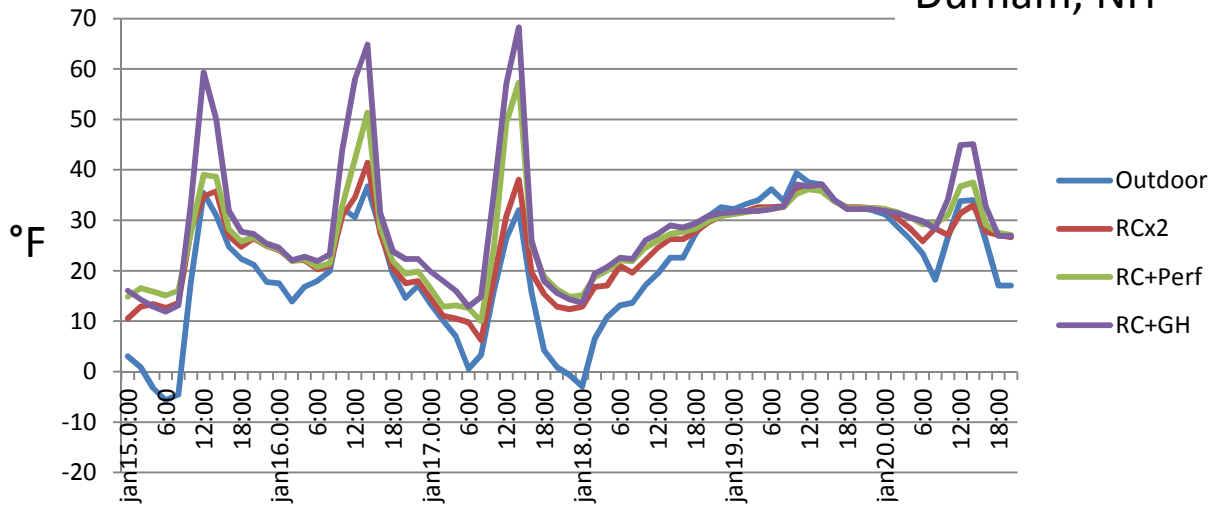


KEY: **RCx2** = two layers 1.25 oz rowcover, **RC+perf** = 1layer rowcover plus 1 layer perforated plastic, **RC+GH** = 1layer rowcover plus 1 layer 6mil greenhouse poly. Disclaimer: The accuracy of daytime readings in the sun depends on whether probe was adequately shielded from solar radiation. These values should be considered comparative only.

January 15 through January 20, 2011

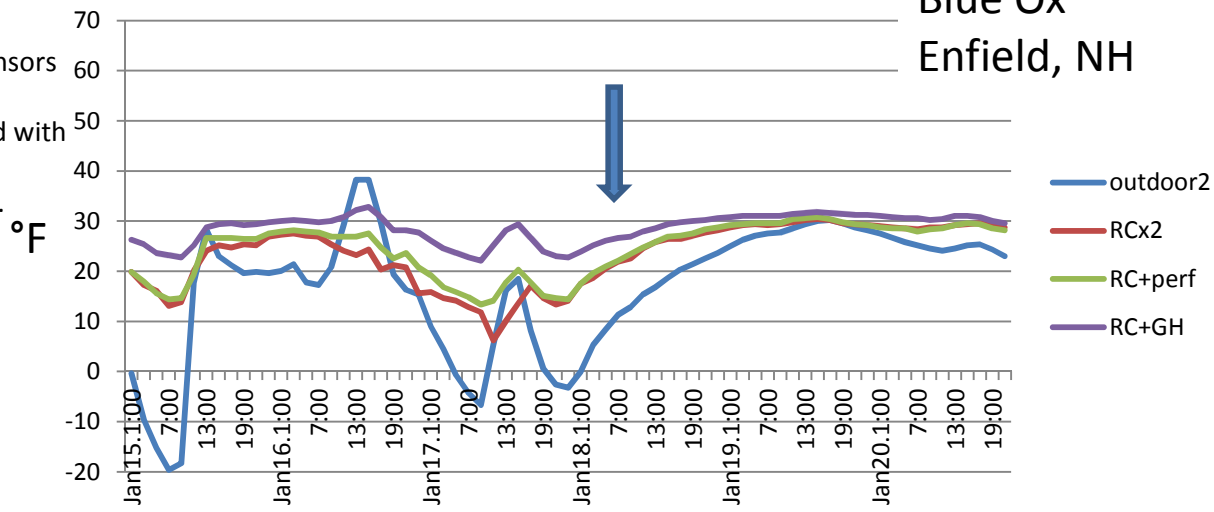
Snowfall that covered tunnels in Enfield and Meredith took place on 1/18 and 1/1
Snow did not entirely cover tunnels in Durham.

Woodman
Durham, NH



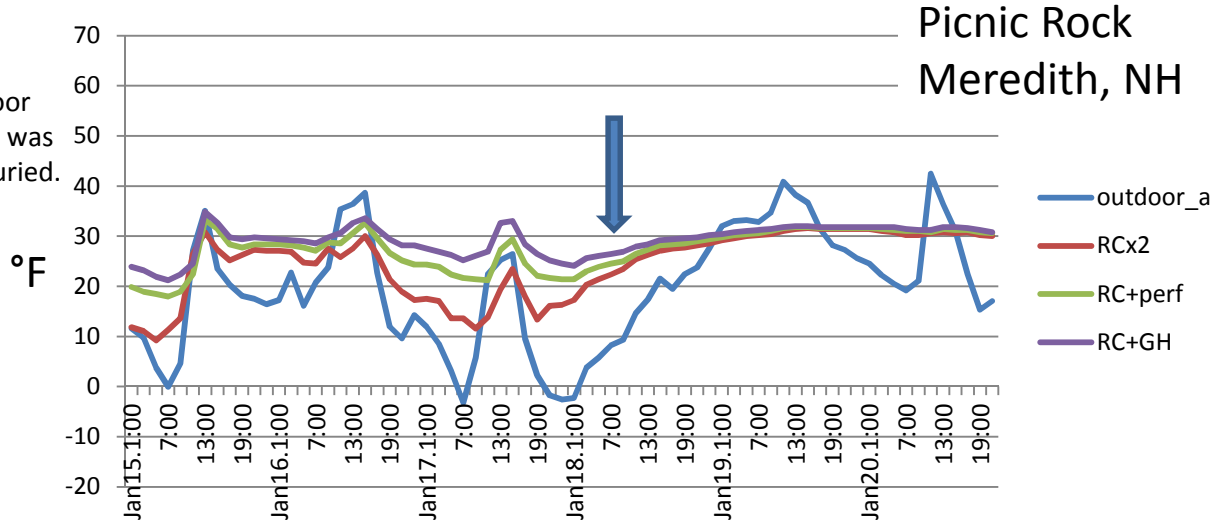
All sensors were buried with snow event.

Blue Ox
Enfield, NH



Outdoor probe was not buried.

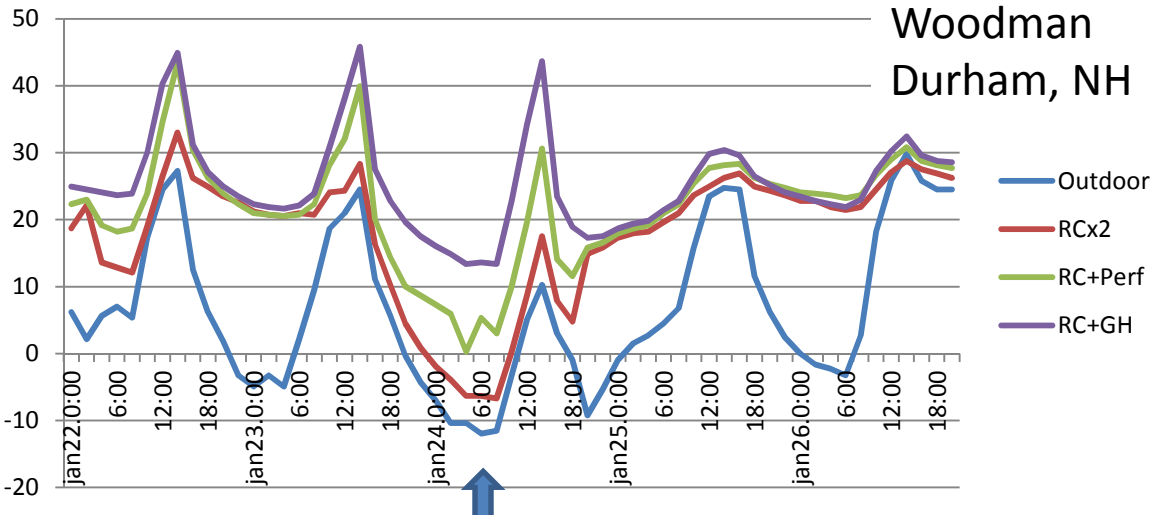
Picnic Rock
Meredith, NH



January 22 through January 26, 2011

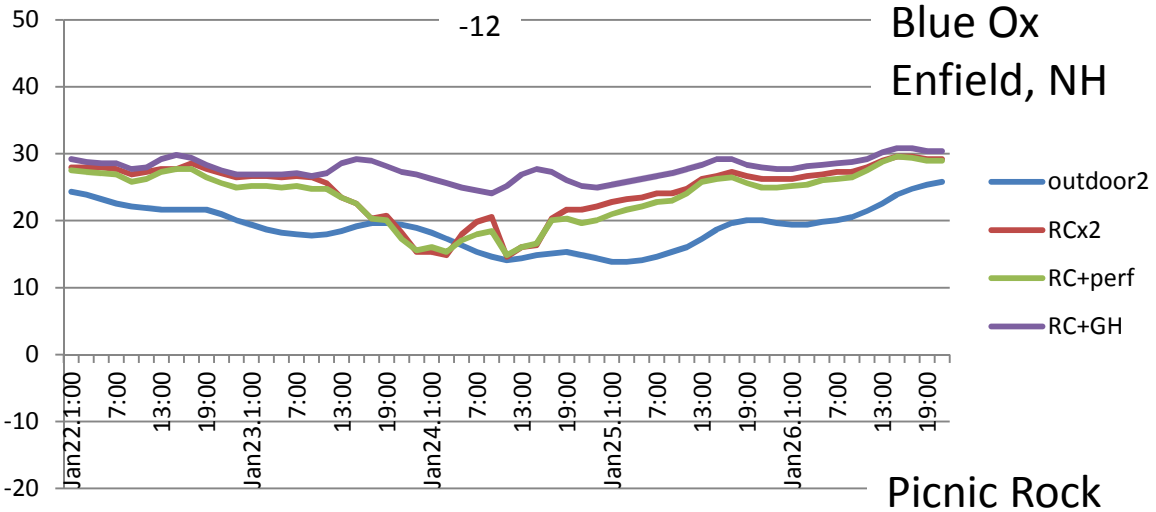
The coldest point of the winter occurred on 1/24.

No snow cover. Weather stations near Durham showed lows of -8, -9.

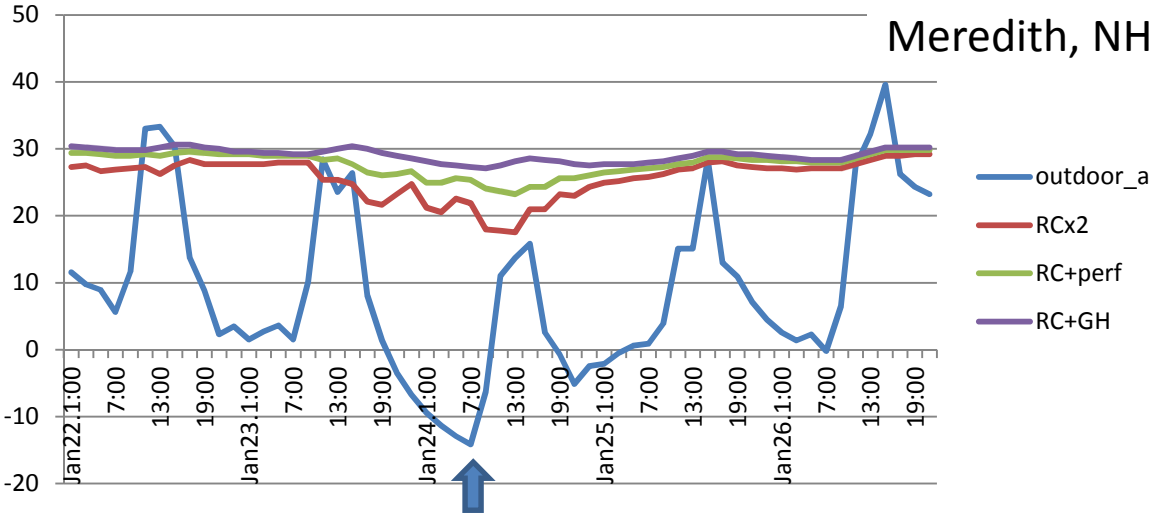


-12

Snow covering all tunnels *and* outdoor sensor. Weather stations near Enfield indicated lows of -18, -21 and -28.



Snow covered all tunnels, but outdoor probe uncovered. Weather stations in Meredith showed lows of -13, -14.



-14.4