Multi-Span High Tunnels

Watermelon growing in a multispan high tunnel.

High tunnels produce a warm, sheltered production environment, leading to earlier and higher yields, especially for warm season vegetable crops. High tunnels can enhance profitability if growers use suitable production practices to grow high value crops. A major limitation of the first generation of high tunnels was that they were relatively small – typically only 10-15' wide, 8' tall and 100' long. The small size of the high tunnels limited the range of crops which could be grown and made it difficult to use full size field equipment within the tunnels. Temperatures within the high tunnels also tended to fluctuate rapidly.

In 2011 and 2012 we evaluated the performance of an 8 bay gutter-connected high tunnel complex - with each unit being 28' wide, 18' tall and 200' long. Crop performance within the larger multi-span high tunnel (MSHT) was compared to crops grown in the open and/or to crops grown in a small single span high tunnel (SHT).

Observations on the Performance of the Multi-Span High Tunnels

A) The multi-span high tunnels cost 50-70% less per unit area than the standard single span high tunnels.
B) Installation of the aluminum pipe framework for the high tunnel complex was relatively straightforward. However, installation of the covers was difficult. The sheets of polyethylene were large (40' wide* 240" long), heavy, and difficult to install even in light winds. Under ideal conditions it took two hoist trucks and a crew of 10-15 people 1.5 hours to install each section of cover.
C) Standard field equipment such as 8' wide rotovators, field sprayers, mulch layers and manure spreaders easily fit within the high tunnels. This facilitated crop management.
D) Temperatures in the high tunnel complex ran about 5^{o}C warmer than outside conditions. The high tunnels also provided about 4^{o}C of frost protection. Temperatures within the MSHT complex were consistently cooler than in the smaller single span high tunnels.
E) The 6 mil polyethylene used to cover both types of high tunnel screened out a significant portion of the incoming light. This would have slowed crop growth unless the tunnels were providing some counter-balancing benefit such as like enhancing temperatures around the crop.
F) The multi-span tunnels came through the first growing season (2011) in relatively good conditions. There were a few tears in the plastic but these were easily mended.
G) The recommended practice is to remove the polyethylene covers on the MSHT for the winter – as this reduces wear on the covers and the snow load on the structure. However as installation of the covers was slow and costly, we have opted to leave the covers in place over the winter, just opening the roof panels enough to allow the snow to slide off. The structure came through the winter of 2011/2012 in relatively good condition – although it is noteworthy that the winter was mild with limited snowfall.
H) On June 27, 2012 a rain storm with wind gusts to 94 km/h tore the covers off 5 of the 8 tunnels and caused significant damage to the structural components in 3 of the tunnels. This wind event also tore the cover off nearby single span high tunnels – but did not cause any damage to the structural elements.

I) By the fall of 2012 only one of eight spans in the tunnel complex still had an intact cover – as small holes in the cover caused by previous wind events expanded with each subsequent event.
J) The last tunnel with an intact cover collapsed following an early wet snow event.

Observations of Crop Performance in the Multi-Span High Tunnels

a) There were few consistent differences in pest problems or disease pressure inside the high tunnels versus crops growing in the open – except for mice which appeared to thrive in the sheltered food-rich environment of the high tunnels.
b) Most crops grew more slowly in the multispan high tunnel than in the smaller single span high tunnel. This likely reflects the reduced light levels and more moderate temperatures in the multispan tunnels.
c) Fruit set was generally superior in the multi-span high tunnels relative to the standard single span units. Pollen development and release may have been favored by the moderate temperatures of the multispan high tunnels. The more open and moderate environment in the MSHT may also have been more conducive to pollination by insects (melons) and by wind (tomato and pepper).
d) Tomato plants in the multi-span high tunnels were smaller than in the standard high tunnels – but set fruit earlier and produced superior yields.
e) Watermelons matured earlier and produced more fruit/plant in the multispan high tunnels than for the smaller single high tunnel unit.
f) Lettuce, broccoli and cabbage grew well in both types of tunnel.
g) Getting day neutral strawberry plants established was difficult in both types of high tunnel. Once established, the day-neutral strawberries did well in the high tunnels – although no major advantage in terms of fruit yield or quality was observed relative to growing the crop under open field conditions. Spider mites were more of a problem in the dry warm high tunnels than in the field.
h) Raspberry plants grew more quickly and yielded fruit earlier in the high tunnel than in the open.

Conclusions and Recommendations

Multi-span high tunnels (MSHT) have some clear-cut management advantages over the standard single span high tunnels. The larger size of the MSHT allows for a wider range of crops to be grown and makes it easier to mechanize production. The more moderate temperatures in the multispan high tunnels resulted in higher fruit yields in crops such tomato, pepper, watermelon and muskmelon relative to crops in standard single span high tunnels. Excellent quality crops of cool season vegetables such as lettuce, broccoli, cabbage and spinach could be grown in the multispan high tunnels. Keeping newly planted crowns of day-neutral strawberries supplied with adequate water was challenging within all types of high tunnels.

The greater size of the multispan high tunnels made it difficult to install and remove the covers. The high tunnels were not structurally strong enough to withstand the winds associated with even moderately severe storm events. They also could not bear a significant snow load. While the multi-span high tunnels may have a low purchase price, this cost must be balanced against higher construction and maintenance costs as well as concerns about durability and failure risk of these structures.