UNIVERSITY OF SASKATCHEWAN

VEGETABLE CULTIVAR AND CULTURAL TRIALS

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Saskatchwan Agriculture and Food

Multi-Span High Tunnels

Watermelon growing in a multispan high tunnel in 2011.

The University of Saskatchewan has conducted a number of research projects to evaluate the potential to use high tunnels as a means to enhance yields and profitability of vegetable crop production in Saskatchewan. Trials conducted from 1998 – 2008 showed that the high tunnels produced a warmer production environment than standard field conditions – resulting in earlier and higher yields – especially for warm season vegetable crops. Economic analyses indicated that the high tunnels could enhance profitability if growers used suitable production practices. 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 size of the high tunnels limited the range of crops which could be grown, made it difficult to use full size field equipment within the tunnels, and temperatures within the high tunnels tended to fluctuate rapidly.

In 2011 we began testing the next generation high tunnels – an 8 unit gutter-connected tunnel complex, with each unit being 28' wide, 18' tall and 200' long. Crop performance within the 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).

General Observations

a) The multi-span high tunnels cost 50% 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 for each high tunnel range was difficult. The sheets of polyethylene were large (40' wide* 240" long), heavy, difficult to manoeuvre and prone to catching the wind during installation. Even under ideal conditions it took two hoist trucks and a crew of 10-15 people 1.5 hours to install each section of cover. The covers were impossible to install if wind speeds exceeded 10km/h. The height of the tunnels (7' at the eaves and 18' at the peak) also meant that all work on the covers involved positioning the crew on ladders or hoists – this slowed the installation and increased associated costs.
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) Soil quality within the high tunnel was compromised by the extensive machine and foot traffic required to build and cover the tunnels. This should not be an issue in subsequent years.
e) 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 slightly cooler than in the smaller single span high tunnels.
f) 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 enhancing temperatures around the crop.
g) There were few consistent differences in pest problems or disease pressure inside the high tunnels versus crops growing in the open.

h) 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.
i) Fruit set was generally superior in the multi-span high tunnels relative to the standard single span units. The more open and moderate environment in the MSHT may be more conducive to pollination by insects (melons) and by wind (tomato and pepper).
j) Tomato plants in the multi-span high tunnels were smaller than in the standard high tunnels – but set fruit earlier and produced superior yields.
k) Watermelons matured earlier and produced more fruit/plant in the multispan high tunnels than for the smaller single high tunnel unit.
l) Lettuce and broccoli developed far more quickly in the single span high tunnel than in the multispan tunnel. Three sequentially planted crops of lettuce and two crops of broccoli were grown to maturity within a single growing season in the SHT while only two lettuce crops and a single broccoli crop matured in the MSHT over the same time period. The quality of the broccoli crop grown in the SHT was also superior to the crop grown in the MSHT. However one of the lettuce crops in the SHT was severely damaged by tipburn during a period of hot weather in mid-summer. There was little tipburn in the cooler MSHT.
m) 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 proved to be a slow and costly process, 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. Leaving the covers in place should provide a head start for soil warming in the spring.

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. However it appears that light levels are lower in the MSHT and this could slow crop growth. The larger size of the individual tunnels and the tunnel complex may also create problems with ventilation and temperature gradients – particularly if the sides and endwalls are in place.

It is not possible to make any cropping recommendations for the MSHT based on only a single production season. However some crops like tomato and watermelon appeared to thrive within the MSHT while others like lettuce and broccoli may be less suited to that environment.

In 2012 the side and endwalls will be installed in the MSHT complex. This should raise the temperatures within the complex – resulting in an earlier start to the growing season and more rapid early growth, but potentially causing problems with heat stress by mid-summer. The same range of vegetable crops tested in 2011 will be evaluated again in 2012 – along with fruit crops which may potentially benefit from the high tunnel environment.