High Tunnels for Late Fall Raspberries

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Raspberries are a high value crop that, in the middle of winter, can sell for more than $10.00/lb. A high tunnel is simply a large hoophouse covered with plastic. There are no fans, heaters or lights and can be used to extend fall raspberries later in October and November, after the field season ends from frost and rain, and when price is high.

Producing fruits, vegetables and flowers out-of-season is one way to increase value and income because crops usually can be sold at a higher price at that time. High tunnels is a technology that can be implemented just about anywhere for a modest cost, and can be used to bring crops on earlier or extend them later in the season. A high tunnel is simply a large hoophouse covered in plastic, with sides that can be rolled up or opened for ventilation. High tunnels are not powered by electricity so they do not typically have fans, heaters or lights. Because the plastic covering is generally applied and removed seasonally, and because they are not powered with electricity, high tunnels are usually classified as temporary structures and may fall outside of certain tax, building and zoning requirements.

Plants are set directly into the soil under the tunnel. Tunnels are high and wide enough to allow tractors to spray and cultivate. A typical size is 15 to 30 feet wide and 96 feet long. Europeans have been using this technology for years, and often connect several tunnels together (Figure 1). The Chinese also have been using a type of tunnel technology to produce fruits and vegetables (Figures 2 and 3). Because the United States is so geographically large, we have found it economical to grow crops in the south and ship them north to extend the season. However, even in warm climates, tunnels are helping to improve fruit quality (Figure 4). Researchers at Penn State University have demonstrated that many crops can be grown under tunnels in the Northeast. Our objective was to take one of the most promising crops and push the limits of season extension.

Raspberries are a high value crop, that in season, sell for more than $3.00/lb. In the middle of winter, raspberries can sell for more than $10.00/lb. Our goal was to produce raspberries in October and November, after the field season ends from frost and rain, and when the selling price of raspberries increases. We planted primocane-fruiting raspberry varieties, managed them in various ways to delay their production beyond the normal late August-September season, and then fruited them under a plastic tunnel.

Primocane-fruiting raspberries were planted in April of 2004 in 4 rows spaced 7 ft apart. Plots were 16 ft. long (6 per row). All canes were mowed to the ground in the fall of 2004 after summer's growth. In spring of 2005, we installed the framework for a tunnel over the planting.

Figure 1. Raspberries under a high tunnel in Scotland.

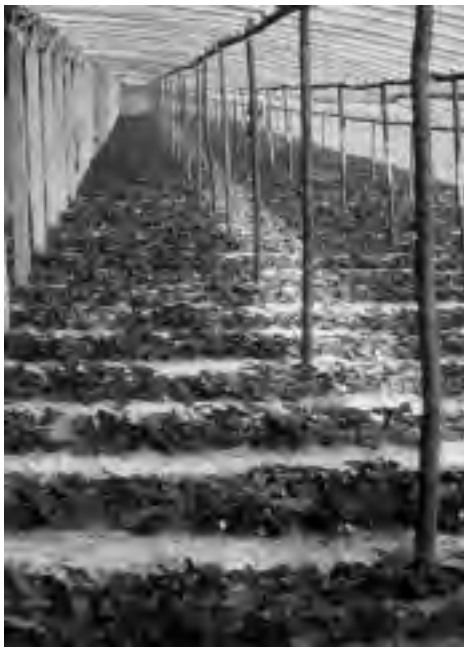

Figure 2. Strawberries grown under a Chinese tunnel.

Figure 3. Partial high tunnels along the Great Wall of China are used to produce early fruits and vegetables.

Figure 4. Raspberries under rain shelters in central California.

Figure 5. High tunnel planting on October 22, 2005.

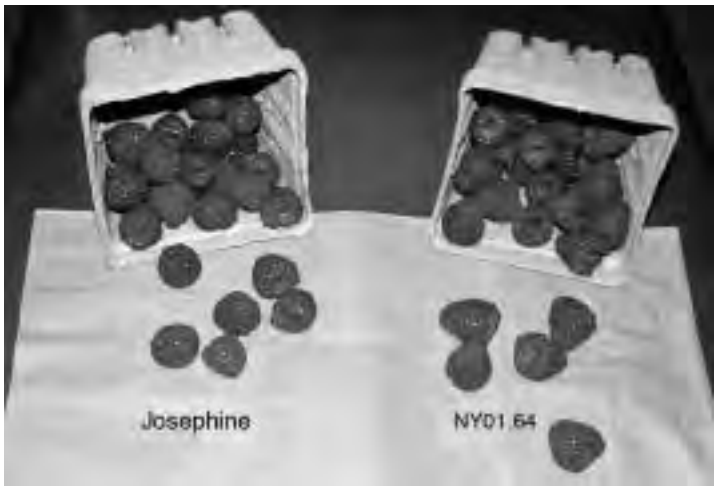

Figure 6. Raspberries harvested in Ithaca in early November.

The tunnel was covered with plastic on September 13, 2005, just prior to harvest.

Typically, a grower would prefer that fall-bearing types fruit early to avoid frost so a full harvest can be realized. Our objective was to delay fruiting of 'Heritage' until late in the fall when they would be protected by the high tunnel, and when the availability of fresh raspberries is low and the price is high. Five treatments were used: an unmanipulated control, application of straw over plots in late February to delay cane emergence, mowing canes to the ground in early June shortly after they emerge, pinching primocanes (removing the top 4 – 6 inches) when they reach a height of about 2 ft., and pinching when canes were 3 ft. tall. Each of these manipulations delayed flowering and shifted production later in the season.

A second experiment examined several high quality varieties that often cannot be completely harvested due to frost. These varieties were Caroline, Josephine, Autumn Britten, NY01.63, NY01.64, and NY01.65. The numbered selections were made by fruit breeder Courtney Weber who suspected that they may have traits that allow them to perform well in high tunnels.

Harvest started in early September at the normal time. Tunnel sides were rolled up in the morning and closed in the evening to regulate temperature. As the weather turned colder, outdoor plants slowed their production and fruit quality deteriorated. October was characterized by record rainfall, so any outdoor fruits that survived were moldy and tasteless. Inside the tunnel, however, fruit quality remained high (Figure 5) and harvest continued into November (Figure 6). On particularly cold nights, we covered the plants with row cover since tunnels do not provide suficient frost protection (Figure 7). On most nights, however, we simply closed the sides and doors of the tunnel while allowing some ventilation during the day.

We were concerned that pollination would be a problem in the fall, so we thought we would need a beehive. However, native bumble bees were attracted to the house in large numbers, without adding a hive. The stayed in the house continuously, sleeping under the leaves and foraging on raspberry flowers during the day.

Yields were high; we averaged nearly 2 lbs. per ft. of row in control plots of Heritage. Because rows were closer together than in the field, our yield per unit area was about 4 times higher than yields from outdoor plantings. Since much of the fruit was produced out-of-season, we sold our fruit at the Cornell Orchards store for $5.00 / pint ($6.70 / lb). Assuming that all of the plants in the tunnel produced as well as the Heritage controls, and assuming that we could sell everything from the tunnel, our gross sales from our 96 ft long x 30 ft wide tunnel would have been $5,150. Extrapolating to an acre, the value of the crop would be close to $80,000.

Material costs for the tunnel were about $5,000 and labor added another $1,000, so sales from the first year were nearly enough to cover the cost of the tunnel materials. Of course, labor and other costs have to be covered from the first year sales, but even so, our preliminary observations suggest that high tunnels will be profitable in the long run. We have obtained support from the New York Farm Viability Institute to document the profit potential over several years.

A second aspect of our study was to evaluate how other varieties performed in the tunnel, particularly those that fruit too late for the field. Josephine produced outstanding fruit quality in the tunnels and fruited quite late without manipulation. The other varieties also performed well, but their season was similar to that of Heritage. Autumn Britten produced large fruit, but yields were smaller than Heritage. The selections were not quite up to cultivar standards, but they were certainly late and one selection had enormous fruit size.

We plan to follow this first year's observations for another year and collect detailed economic data for analysis. We also plan to construct a second tunnel to examine early season blackberries, strawberries, and dayneutral strawberries.

Energy and transportation costs will no doubt continue to rise, and knowing that high tunnels use free solar energy, it may worth considering placing a few high tunnels on the farm to extend the season of the most highly valued crops.

Figure 7. Row covers used to protect raspberry plants on extremely cold nights in November.

Marvin Pritts is a research, teaching and extension professor and chairman of the Horticulture Department at Cornell University in Ithaca, NY. He also leads Cornell's berry crops program.