

Production of Sweet Cherries under High Tunnels in Either the Modified Spanish Bush and the Tall Spindle Systems

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Production of sweet cherries in humid climates like NY State is constrained by rain induced fruit cracking. The introduction of dwarfing cherry rootstocks has allowed

“We compared two high density sweet cherry planting systems (Tall Spindle and the Modified Spanish) inside and outside of plastic-covered high tunnels. After 5 years, cumulative yield was highest for the Tall Spindle at the 1m spacing (36 t/ha) while the lower density Tall Spindle (2m spacing) and the two densities of the Modified Spanish Bush system had lower yield (~25 t/ha). Gi.5 rootstock produced higher yields and higher cumulative crop value than G.6. High tunnels increased yield, gave good control of fruit cracking and increased crop value, but not yet enough to pay for the tunnel after 3 cropping seasons.”

new possibilities for developing high-density cherry orchards with smaller trees that are more precocious and productive and that can be either covered with rain exclusion shelters or high tunnels to prevent rain fruit cracking (Lang, 2005; Robinson et al., 2004). Several high-density training systems have been developed for sweet cherries giving fruit growers

many options for choosing a planting density, rootstock and training protocol. The objective of this project was to compare 2 high-density production systems on dwarfing rootstocks for both self-fertile and self-infertile sweet cherries grown in a high tunnel.

Materials and Methods

In May, 2008, we planted a replicated field trial at Geneva, New York with ‘Rainer’ on Gisela 5 (Gi.5), and Gi.6 rootstocks and, ‘Lapins’, ‘Regina’ and ‘Sweetheart’ on Gisela 6 (Gi.6) Each variety/rootstock combination was planted in two training systems: Tall Spindle (TS) and Modified Spanish Bush (our version of the Kym Green Bush, KGB). Within each training system, trees were planted at two in-row spacings: 1m and 2m. The between row spacing was 3.6m giving planting densities of 1,366 and 2,732 trees/ha. Two of the three replicates were covered with a Haygrove high tunnel while the third replicate was grown with no cover.

The Tall Spindle system was developed by heading the leader at 120cm at planting and stubbing back any lateral branches to a 3cm stub. In addition, 2 out of 3 buds along the tree



Figure 1. Modified Spanish Bush (top) and Tall Spindle (bottom) sweet cherry trees in the 5th year under high tunnels at Geneva, NY.

trunk were removed at bud swell. The bud removal process was repeated in years 2 and 3 on the 1 year-old portion of the trunk. This resulted in 15-18 lateral shoots along the trunk. Beginning in year 4 the trees were pruned each spring at bud swell by removing 1-3 of the largest limbs (>5cm) along the trunk by cutting them back to a 15 cm long stub or to a sub-lateral branch.

The Modified Spanish Bush trees were developed by repeated heading of the tree. First at 45cm above the soil at planting and allowing 3-4 vertical shoots to grow and heading each of those again in late June to produce 10 upright shoots for the 1m spacing. In the spring of the second year all of the vertical shoots of the 2m spaced Spanish Bush trees were re-headed to 15cm long stubs and then again on July 1 to produce 20 upright shoots. Beginning in year 3 the trees were topped at 2.5m after harvest and the lateral shoots on each of the 10 or 20 vertical fruiting branches was removed leaving long columns of spurred shoots.

Yield, fruit size, soluble solids, and proportion of cracked fruit were recorded each year and trunk circumference at the end of the experiment. A fruit packout was calculated and economic crop value was calculated by first subtracting yield of cracked fruit from total yield and then calculating crop value of each fruit size class. The effect of the tunnel on cracking was evaluated by comparing the effect of rep 1 and 2 compared to rep 3.

Results

Systems The trees in both the Tall Spindle system and the Modified Spanish Bush system grew well in the first and second year. The trees flowered in the third year and produced a good yield. The trees planted at the 1m spacing had significantly higher 3rd year yield than those planted at the lower density of 2m

between trees (Figure 1). At the 1m spacing there was no difference in yield between the Tall Spindle system and the Modified Spanish Bush system while at the 2m spacing the Tall Spindle system had significantly higher yield than the Spanish Bush. Among varieties, yields in the 3rd year were highest for Lapins followed by Rainer and lowest with Sweetheart.

In the fourth year, the yield of the Tall Spindle system declined slightly while the yield of the Modified Spanish Bush system increased resulting in significantly greater yield with the Spanish Bush. Within the Tall Spindle system, the 1m spacing continued to have higher yield than the 2m spacing but with the Spanish Bush system there was no difference in yield between the two tree spacings. Among varieties, Rainer had the highest 4th year yield followed by Lapins and Sweetheart which had the lowest yield.

In the fifth year the yield of the Tall Spindle was greater than the Modified Spanish Bush. With the Tall Spindle, the 1m spacing continued to have higher yield than the 2m spacing but with the Spanish Bush system the 2m spacing had higher yield than the 1m spacing.

There was an interaction of spacing and system on cumulative yield (Figure 2). With

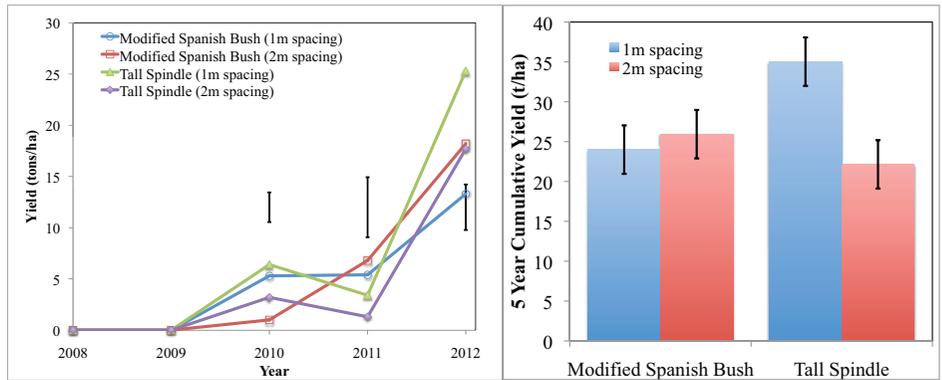


Figure 2. Interaction of plant spacing and training system on annual yield/ha (left figure) or cumulative yield/ha (right figure) of 3 sweet cherry cultivars (Lapins, Rainer, Sweetheart) on Gi.6 rootstock over the first 5 years at Geneva, NY.

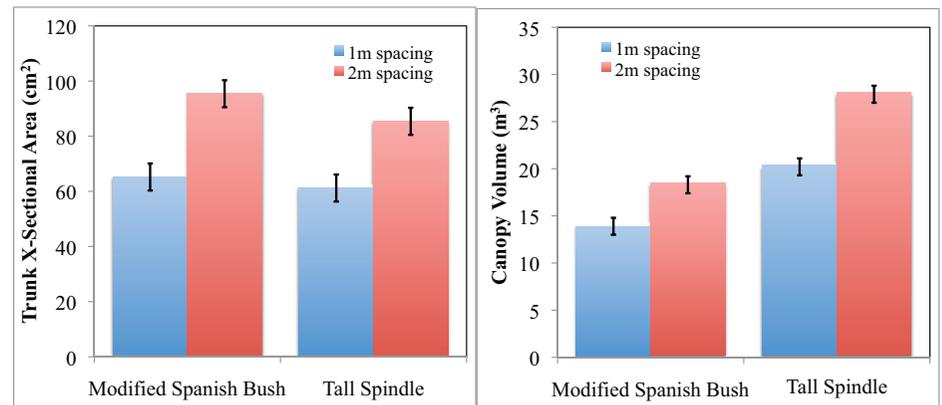


Figure 3. Interaction of plant spacing and training system on trunk cross-sectional area (left figure) or canopy volume (right figure) of 3 sweet cherry cultivars (Lapins, Rainer, Sweetheart) on Gi.6 rootstock over the first 5 years at Geneva, NY.



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the Tall Spindle, the 1m spacing had higher cumulative yield/ha than the 2m spacing but with the Modified Spanish Bush, the 1m and the 2m spacing had similar cumulative yields. The Tall Spindle system at 1m spacing had higher cumulative yield/ha than the Modified Spanish Bush or the low density Tall Spindle.

Tree size as measured by trunk cross-sectional area (TCA) after 5 years was smaller with the 1m spacing than at the 2 m spacing for both systems (Figure 3). Canopy volume was greater for the 2m spacing than the 1m spacing. Training system did not affect TCA but did affect canopy volume. The Tall Spindle system had a greater canopy volume than the Modified Spanish Bush.

Yield efficiency when based on TCA was higher for the Tall Spindle at the 1 or 2m spacing than the Modified Spanish Bush at 1m (Figure 4). However when yield efficiency was based on canopy volume then efficiency was higher for the Modified Spanish Bush at 2m spacing than the Tall Spindle or the Modified Spanish Bush at 1m spacing.

Fruit size of the Modified Spanish Bush was larger than the Tall Spindle (Figure 5). There was no effect of spacing on fruit size. Fruit soluble solids were not different among systems or spacings (Figure 5).

Light exposure in the lower canopy of the Modified Spanish Bush was very low even with the use of reflective film “Extenday”. There was no effect of this reduced light level on average fruit size or fruit soluble solids. The use of Extenday in the plastic tunnels improved light levels in the lower canopy but not in the middle or upper canopy.

Cumulative crop value was highest for the Tall Spindle system at the 1m spacing while the other 3 systems had lower and similar cumulative crop value (Figure 6). With the Modified Spanish Bush, there was no difference in cumulative crop value between the 1m and 2m spacings.

Rootstock With Rainer we compared the performance of Gi.5 and Gi.6 rootstocks. Gi.5 induced greater yields of Rainer cherry but with similar fruit size and soluble solids concentration (Figure 7). Rainer on Gi.5 rootstock had greater cumulative crop value than trees on G.6.

Tunnel The use of a high plastic tunnel to grow high-density sweet cherries resulted in increased yield, reduced fruit cracking and improved cumulative crop value regardless of system, rootstock or cultivar (Figure 8). The increase in crop value has been about \$38,000/ha over the first 5 years.

Discussion

Our results after 5 years show the strong positive relationship of tree planting density and cumulative yields with the Tall Spindle system but not with the Modified Spanish Bush. The level of cumulative yield with the high-density Tall Spindle plantings was 1.5 times the level of low-density plantings. This is similar to the results of planting density studies with cherry and apple (Robinson, 2003). The Spanish Bush system at the 2m spacing gave lower initial yield in the third year compared to the 1m spac-

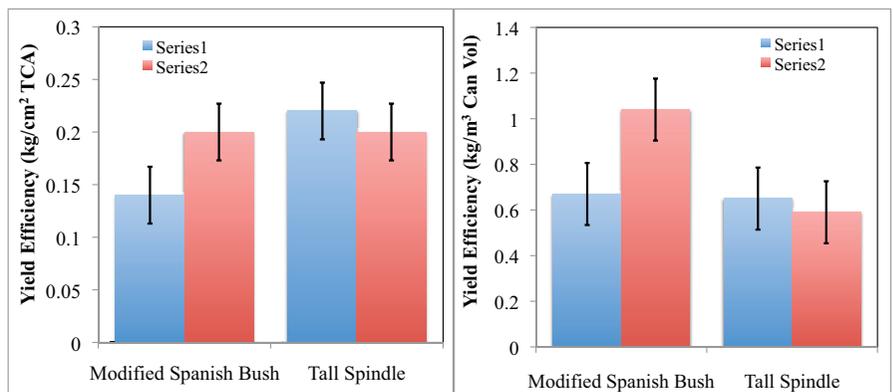


Figure 4. Interaction of plant spacing and training system on cumulative yield efficiency based on TCA (left figure) or cumulative yield efficiency based on canopy volume (right figure) of 3 sweet cherry cultivars (Lapins, Rainer, Sweetheart) on Gi.6 rootstock over the first 5 years at Geneva, NY.

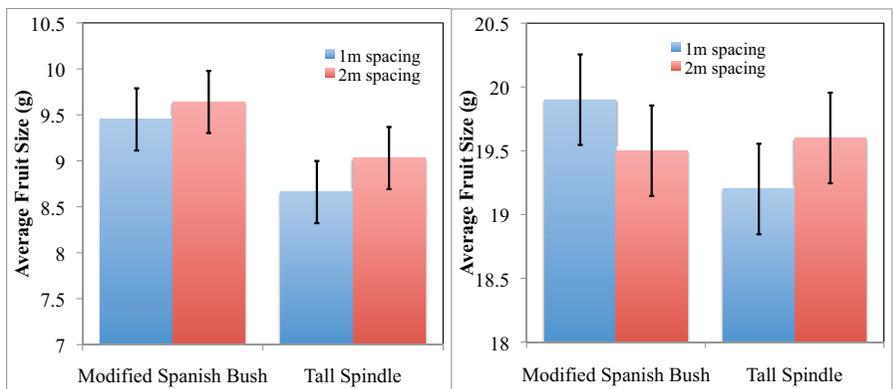


Figure 5. Interaction of plant spacing and training system on average fruit size (left figure) or average fruit soluble solids (right figure) of 3 sweet cherry cultivars (Lapins, Rainer, Sweetheart) on Gi.6 rootstock over the first 5 years at Geneva, NY.

ing but in the 4th and 5th years the 2m spacing did as well or better than the 1m spacing resulting in no effect of planting density on cumulative yield with the Modified Spanish Bush. This was likely due to the design of the trees at each spacing, which resulted in 10 upright fruiting shoots per tree at the 1m spacing but 20 upright shoots/tree at the 2m spacing. This resulted in a similar number of upright fruit-

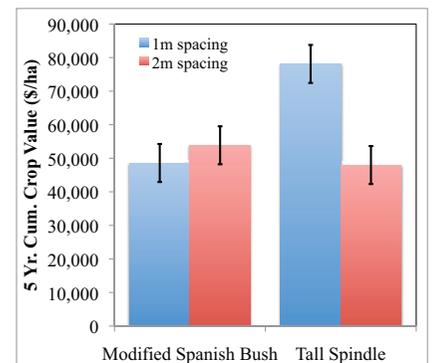


Figure 6. Interaction of plant spacing and training system on cumulative crop value of 3 sweet cherry cultivars (Lapins, Rainer, Sweetheart) on Gi.6 rootstock over the first 5 years at Geneva, NY.

ing shoots/acre between the two spacings, thus similar cumulative yield. The lower yield of the Modified Spanish Bush compared to the Tall Spindle was due to the greater pruning with Spanish Bush system which received 2 heading cuts (spring and mid summer) of all shoots in both years 1 and year 2 while the Tall Spindle system was not headed. It is clear from this work that to maximize early yield, pruning during the first 2 years must be minimized. To reduce or eliminate this negative aspect of the Modified Spanish Bush system, pre-formed nursery trees should be planted which have multiple leaders when planted. This would eliminate all but the heading cuts in year 1.

The comparison of Gi.5 and Gi.6 showed that Gi.5 is a superior rootstock to Gi.6 when planted at high tree densities and grown under tunnels since it results in greater yield with similar fruit size and quality resulting in greater crop value over the first 5 years.

Another important result is that covering cherry trees with a high tunnel can significantly reduce fruit cracking in humid climates like New York State. With cracking sensitive cultivars like Rainer, this can be worth ~\$38,000 per ha over the first 5 years (first 3 cropping years). Although cracking was reduced under the tunnel it was not completely eliminated. The economic value of the tunnel is not clear due to the high cost of purchasing the tunnel. Although the tunnels have reduced

cracking and increased cumulative crop value by \$38,000/ha, the cost of the tunnel is about \$70,000/ha so the tunnel has not paid for itself in the first 3 cropping years. A complete economic analysis will be done after a few more years but it is likely that the tunnel cost will not be recovered until after year 7 or 8.

Considering both yield, fruit size, and cumulative crop value, the Tall Spindle system is the best system. However the Modified Spanish Bush performed very well in the tunnel. Its major drawback is the repeated heading of the shoots in the first 2 years. However, starting the orchard with pre-formed trees should improve its performance compared to the Tall Spindle. Its main advantage is that it is a pedestrian system, which is easier to harvest than the Tall Spindle.

Conclusions

Our experiment has shown very high early yields of Rainer, Lapins and Sweetheart sweet cherries are possible in the first 5 years with high planting densities. The high-density Tall Spindle system outperformed the high density Modified Spanish Bush system. The Modified Spanish Bush would have performed better if we had planted pre-formed bush trees. There was little benefit to high planting densities (1m vs. 2m) with the Modified Spanish Bush. Gi.5 rootstock produced higher yields and higher cumulative crop value than G.6. High tunnels increased yield, gave good fruit crack control and increased crop value substantially, but not yet enough to pay for the tunnel after 3 cropping seasons.

Acknowledgements

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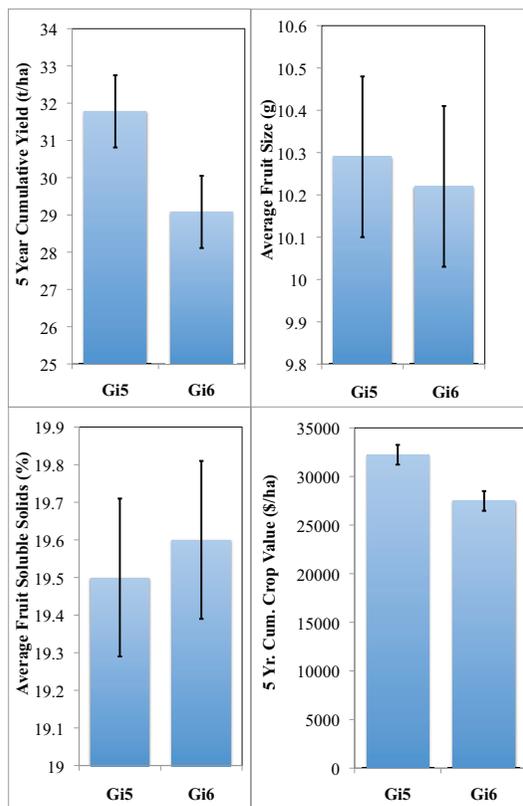


Figure 7. Effect of rootstock on cumulative yield, average fruit size, average fruit soluble solids and cumulative crop value of Rainer sweet cherry cultivar over the first 5 years at Geneva, NY.

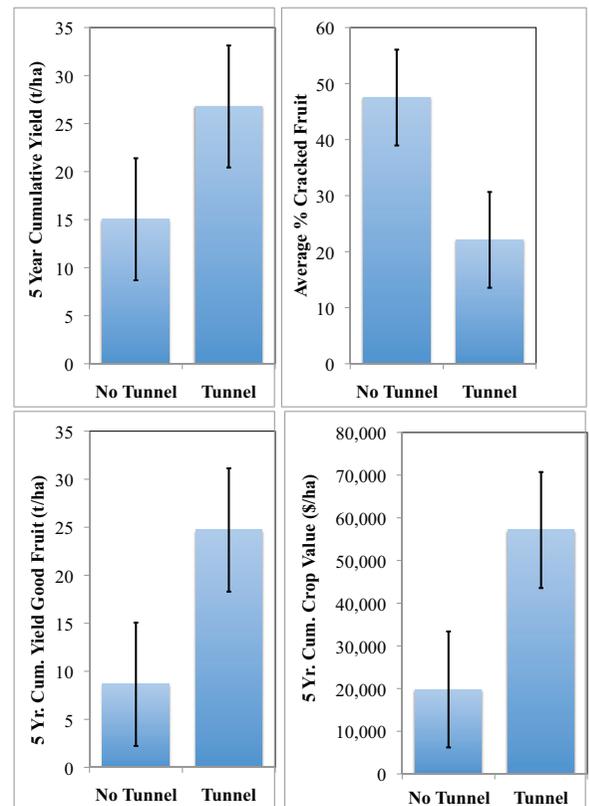


Figure 8. Effect of plastic high tunnel on cumulative yield, average percentage of cracked fruit, cumulative yield of good fruit and cumulative crop value of Rainer sweet cherry cultivar over the first 5 years at Geneva, NY.

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