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High Tunnel Bramble Production

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Abstract
High tunnels are polyethylene covered shelters being used in the vegetable industry to advance or extend the harvest season for many high value crops. Unlike traditional greenhouses, no supplemental heating is used in high tunnels. Brambles(raspberries and blackberries) are high value fruits that have good economic potential on small farms, but under Iowa conditions, they are not without risk. Traditionally, both crops are produced on biennial canes that grow vegetatively the first season (primocanes), and fruit in the second growing season (floricanes).

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Introduction

High tunnels are polyethylene covered shelters being used in the vegetable industry to advance or extend the harvest season for many high value crops. Unlike traditional greenhouses, no supplemental heating is used in high tunnels. Brambles (raspberries and blackberries) are high value fruits that have good economic potential on small farms, but under Iowa conditions, they are not without risk. Traditionally, both crops are produced on biennial canes that grow vegetatively the first season (primocanes), and fruit in the second growing season (floricanes). Because the canes must over-winter, good annual production for floricane red raspberries has not been reliable, while the choice of adapted floricane blackberries is limited to a few less desirable thorny types that are suitable to only the warmest regions of the state. In both crops, there are now cultivars that grow vegetatively and fruit in the same growing season (primocane fruiting). Primocane red raspberries have been available for several years, but because they mature much later in the season than floricane cultivars, they have been difficult to market. Primocane blackberries were just released in 2006. This study was initiated to determine if a high tunnel could be used to improve over-wintering, and if the harvest season of primocane types could be advanced far enough ahead that they could replace the floricane types in such a production system. This report summarizes the results for the 2007 growing season.

Materials and Methods

In 2005, a 30 × 96 ft (2,880 ft^2) high tunnel with a 3-ft rafter spacing and a manual roll-up side venting system was acquired and erected at the ISU Armstrong Research Farm with half the area (30 × 48 ft) designated for growing fruit and the other half vegetables. In 2006, Tulameen (a non-hardy, high quality, floricane, red raspberry), Autumn Bliss (an early season primocane red raspberry), Ouachita (a non-hardy, thornless, floricane blackberry), and Prime Jan (a newly developed, thorny, primocane blackberry) were planted in 10 ft plots spaced 6.5 ft apart in four rows running half the length of the high tunnel. Each cultivar was replicated four times in a randomized complete block design. Because of differences in plant vigor and primocane origin, initial plant spacing was as follows:

Cultivar	Primocane Origin	Vigor	Spacing (ft)
Tulameen	rhizome	medium	2.5
Autumn Bliss	rhizome	medium	2.5
Ouachita	crown	very high	5.0
Prime Jan	rhizome	high	3.3

A companion planting consisting of the equivalent of one replication was established outside to compare harvest dates. A trellis was constructed to support the canes to a height of 6 ft, and water was supplied through trickle irrigation.

In 2006, the plants were allowed to establish. In the fall, the tunnel was kept open to allow the plants to go dormant. Once the leaves dropped, Tulameen and Ouachita plants were covered with straw for additional winter protection. During the winter, the tunnel was vented when inside temperature rose above 60 ^oF and closed when outside temperatures were predicted to drop below 15^oF. In the spring, the floricane cultivars were pruned to optimize cane density as follows: Tulameen, 3-5 canes/ft; and

Ouachita, 6-8 canes/crown. Because 2006 was the establishment year, few if any canes were removed. For the primocane cultivars (Autumn Bliss and Prime Jan), all canes were cut off at the ground. Beginning March 15, the high tunnel was allowed to warm up to begin the growing season. The venting system was manually rolled up when the inside temperature rose above 85–90^{o}F, and closed when the inside temperature dropped below 65^{o}F. By mid-June brambles in the high tunnel had reached the top trellis wire, while outdoor canes had not reached the mid-level wire (Figure 3). Prime Jan canes were approaching 8 ft, and were cut back to the top wire. As the berries matured, they were harvested two to three times per week, counted and weighed. On August 20, high winds blew the cover off the tunnel.

Results and Discussion

The accumulated yield of the primocane cultivars (Autumn Bliss and Prime Jan) was more than three times the floricane cultivars (Tulameen and Ouachita) (Table 1). This difference between the primocane and floricane types can be attributed to differences in the number of fruiting canes. Because the floricane types have a two-year production cycle and 2006 was the establishment year, there were a limited number of floricanes per plot. As the floricane types become better established, fruit yields should go up. On a per acre basis, the yields on Autumn Bliss and Prime Jan were phenomenal based on 6.5 ft row widths. However, for an enclosed production system, such as a high tunnel, production potential has to be considered on a square footage basis and averaged about 0.5 lb/ft^2 for these cultivars.

Compared with the cultivars grown outdoors, the high tunnel advanced the harvest of Autumn Bliss, Ouachita, and Prime Jan (Figure 1). The greatest advance in harvest occurred with Autumn Bliss which came into production five weeks ahead of outdoor plants and a week after Tulameen in the high tunnel. Also, Autumn Bliss plants produced a late crop on floricane-like laterals that developed near the base of the primocanes that had fruited earlier in the season. Heat, high winds, and storms curtailed the production on the plants grown outdoors. Tulameen canes did not survive the winter.

Prime Jan produced the largest berries followed by Ouachita, while Tulameen and Autumn Bliss were similar in size (Table1). The berry size of Tulameen and Autumn Bliss raspberries declined during the harvest season, while the size of Ouachita and Prime Jan blackberries tended to fluctuate (Figure 2). In all cases, berries produced on the plants growing in the high tunnel were generally larger than those from plants being grown outdoors. They were also sounder and exhibited few disease symptoms compared with those grown outdoors.

When the polyethylene cover was blown off on August 20, weekly production and berry size dropped, particularly on Prime Jan (Figures 1 and 2). Gray mold (*botrytis* fruit rot), that was previously only evident on outdoor plants began to show up, and it was three weeks before the cover could be replaced. If the cover had not been blown off, the primocane brambles probably would have been more productive and possibly had a longer harvest season.

If the entire high tunnel were devoted to the production of either Autumn Bliss or Prime Jan, which produced about 0.5 lb/ft^2, total production would project to 1,440 lb/season. If that crop can be direct marketed in ½ pt containers (~ 0.4 lb) at $3.50 per container, the gross income would come to $12,600 or $4.375/ft^2. At an approximate cost of $1.74/ft^2 for the high tunnel with manual roll-up as used this study ($2.60/ft^2 with automated roll-up), growing primocane brambles in a high tunnel could be profitable.

Acknowledgements

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Table 1. Accumulated yield and average berry weight of Tulameen and Autumn Bliss raspberries, and Ouachita and Prime Jan blackberries grown in a high tunnel at the Armstrong Research Farm.

Cultivar	Accumulated yield (lb/ ft)	lb/acre	(lb/ft^2)	Average berry wt. (g)	Number of berries per oz
Raspberries:					
Tulameen	.83 b	5,562	.13	3.5 c	8.2
Autumn Bliss	3.24 a	21,712	.50	3.0 c	9.4
Blackberries:					
Ouachita	.90 b	6,031	.14	6.9 b	4.1
Prime Jan	3.26 a	21,847	.50	9.7 a	2.9

[z]Mean separation by Tukey's HSD (P = 0.05).

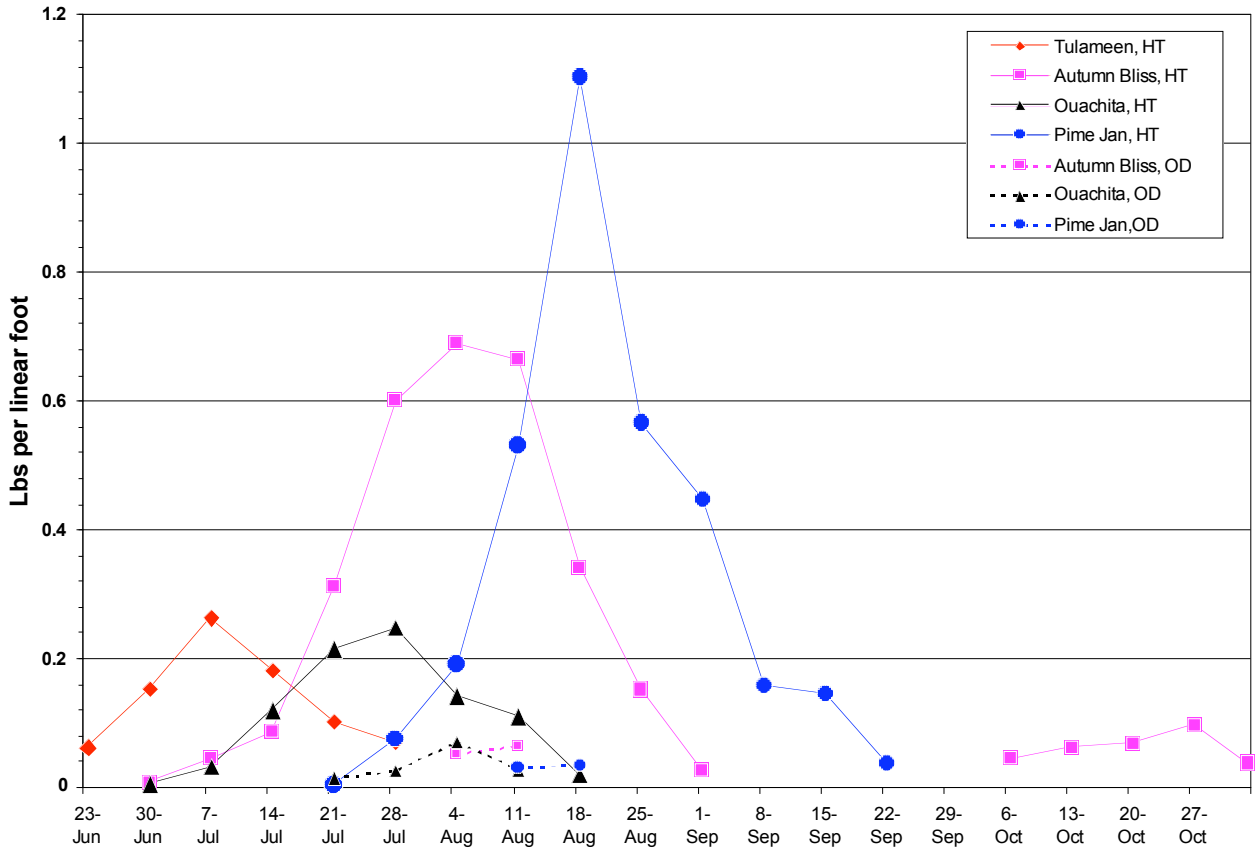

Figure 1. Weekly yield per linear foot of Tulameen and Autumn Bliss raspberries, and Ouachita and Prime Jan blackberries grown in a high tunnel (HT) and outdoors (OD) at the Armstrong Research Farm.

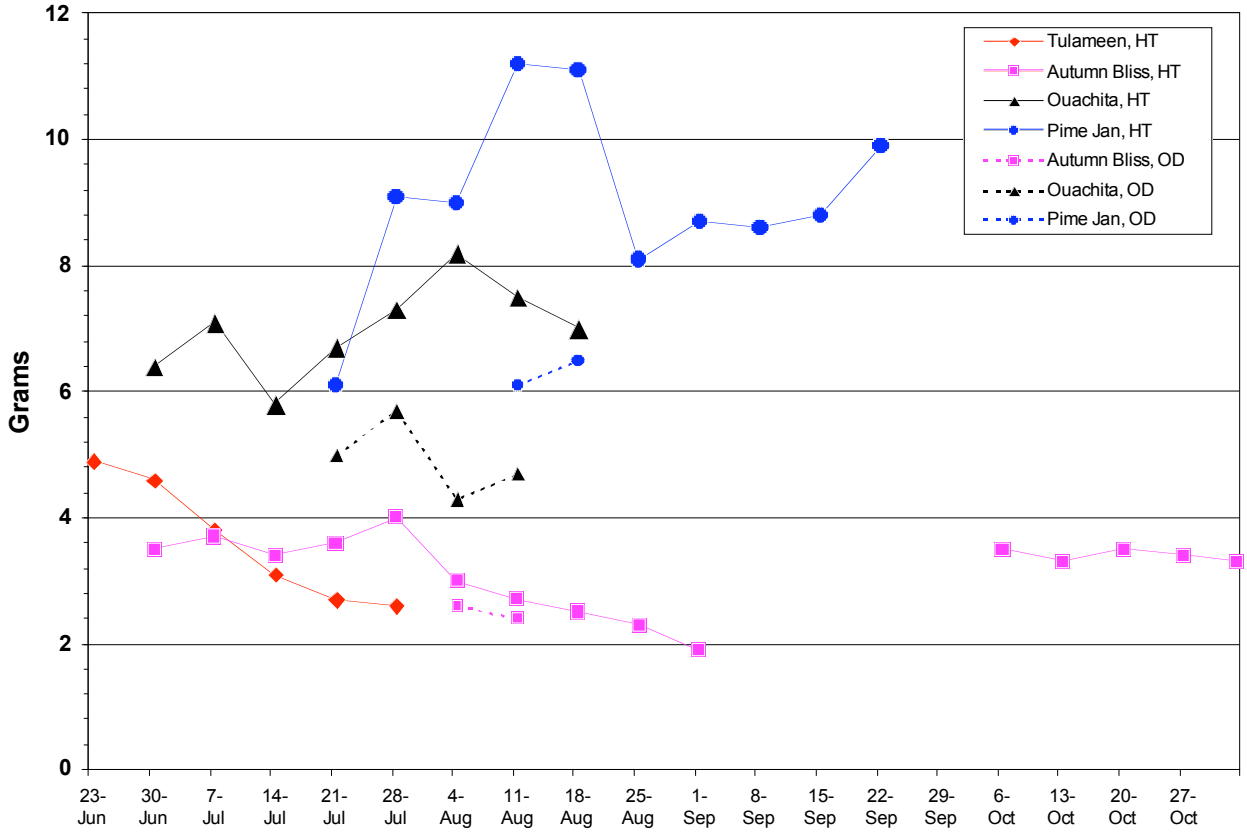

Figure 2. Weekly average berry weight of Tulameen and Autumn Bliss raspberries, and Ouachita and Prime Jan blackberries grown in a high tunnel (HT) and outdoors (OD) at the Armstrong Research Farm.

Figure 3. Brambles being grown in the high tunnel and outdoors at the ISU Armstrong Research Farm photographed in mid-June to show differences in cane development.