# High Tunnel Bramble Production

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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. In 2006, a study was initiated at the ISU Armstrong Research Farm (ARF) and the Horticulture Research Station (HRS) to evaluate the potential for growing high-value floricane and primocane type raspberries and blackberries in a high tunnel. The objectives were to determine if a high tunnel could be used to improve over-wintering of cold sensitive floricane types, and if the harvest season of primocane types could be advanced enough that they could replace the floricane types in such a production system. A second objective was to determine if these crops could be grown in a high tunnel without pesticides or minimum pesticide usage. This report summarizes the results for the 2008 growing season.

## Materials and Methods

In 2005, two 30 × 96 ft (2,880 $ft^2$) high tunnels with a 3-ft rafter spacing and roll-up side venting were acquired and erected at ARF and HRS 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 to one replication was established outdoors at ARF 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. Following the 2007 growing season, Prime Jan was removed from the trial because of excessive thorniness in a confined space and replaced with an advanced Arkansas selection that was not fruited in 2008.

During the 2007–08 winter, the tunnels were vented when inside temperature rose above 60°F and closed when outside temperatures were predicted to drop below 15°F. Tulameen and Ouachita canes were covered with straw mulch for additional protection. In the spring, the floricane cultivars were pruned to optimize cane density as follows: Tulameen, 3 to 5 canes/ft; and Ouachita, 6 to 8 canes/crown. For Autumn Bliss, all canes were cut off at the ground.

Beginning in early April at ARF and mid-April at HRS, the high tunnels at both farms were allowed to warm up to begin the growing season. The sides were rolled up (manual at ARF, automated at HRS) to vent the tunnels when the inside temperature rose above

85-90°F, and closed when the inside temperature dropped below 65°F. When Ouachita primocanes reached a height of 18 in. they were pinched to induce lateral branching.

On May 25, June 27 and July 8, the tunnel at ARF was exposed to high winds in excess of 60 mph. The covering was torn off on May 25 (Figure 3) and July 8, and partially torn on June 27.

## Results and Discussion

At ARF, Autumn Bliss produced the highest accumulated yield per linear foot with no difference between Tulameen and Ouachita (Table 1). At HRS, the yield of Ouachita and Autumn Bliss were similar and greater than Tulameen.

Compared with the 2007 production at ARF, Autumn Bliss was not as productive in 2008, while Tulameen and Ouachita were more productive. The increased production on Tulameen and Ouachita was because of better plant establishment and more canes per plot. However, even with straw mulch applied to moderate the exposure to low winter temperatures in the tunnel, considerable cane die-back following pruning was observed at both sites on Tulameen. Ouachita canes came through the winter in better condition, but much breakage occurred when trying to lay them down in the fall to cover with the straw mulch.

The production potential of Autumn Bliss and Ouachita was affected by an outbreak of *Botrytis* fruit rot that infected the blossoms and developing fruit at both farms (Figure 4). The infection was first observed around August 1, and because we were trying to grow the berries with minimum pesticide usage, no fungicides were applied to control the disease. By late August, weekly yields were greatly reduced (Figure 1). The disease was not a problem in the tunnels during 2007 at either farm. However, the 2007 growing season was warmer and drier in the late summer than in 2008. The tunnels were only vented on the sides, and apparently more humidity was trapped in the tunnels at night creating a more favorable condition for the disease to develop. Consider using fungicides to control *Botrytis* fruit rot beginning at bloom when growing either raspberries or blackberries in a high tunnel. Also, consider taking measures that would allow venting the tunnel near the top.

Berry harvest at both farms began about a week later than in 2007. This delay was probably due to the loss of the cover at ARF on May 25, and the delay in closing the tunnel at HRS. Compared with plants growing outdoors at ARF, Tulameen harvest in the tunnel began one week before outdoors, while Autumn Bliss began two weeks ahead (Figure 1). The Early production of Autumn Bliss at HRS, was from floricanes, or canes that originated off of the below ground stubs of last year's primocanes, and not from primocanes developing from crown buds.

Ouachita produced the largest berries at both farms (Table 1). Autumn Bliss produced the smallest berries, but average size was not statistically smaller Tulameen berries. Tulameen berries exhibited a marked decline in size during the harvest season at both farms, and Autumn Bliss berries tended to be more uniform in size throughout the season, particularly at HRS (Figure 2). Ouachita exhibited a variation in weekly berry size, particularly at ARF.

## Acknowledgements

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**Table 1. Accumulated yield and average berry weight of Tulameen and Autumn Bliss raspberries and Ouachita blackberries grown in high tunnels at the Armstrong Research Farm and the Horticulture Research Station in 2008.**

| Site/Cultivar | Accumulated yield (lb/ ft) | (lb/ft$^2$) | lb/acre | Average berry wt. (g) | Number of berries per oz |
|---|---|---|---|---|---|
| Armstrong Research Farm | | | | | |
| Raspberries | | | | | |
| Tulameen | 1.47 bc | .23 | 10,019 | 3.9 b | 7.3 |
| Autumn Bliss | 2.67 a | .41 | 17,860 | 2.8 bc | 10.0 |
| Blackberries | | | | | |
| Ouachita | 1.71 bc | .26 | 11,326 | 6.5 a | 4.4 |
| Horticulture Research Station | | | | | |
| Raspberries | | | | | |
| Tulameen | 1.04 c | .16 | 6,970 | 3.5 bc | 8.1 |
| Autumn Bliss | 2.21 ab | .34 | 14,810 | 2.5 c | 11.3 |
| Blackberries | | | | | |
| Ouachita | 2.36 ab | .36 | 15,816 | 7.7 a | 3.7 |

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

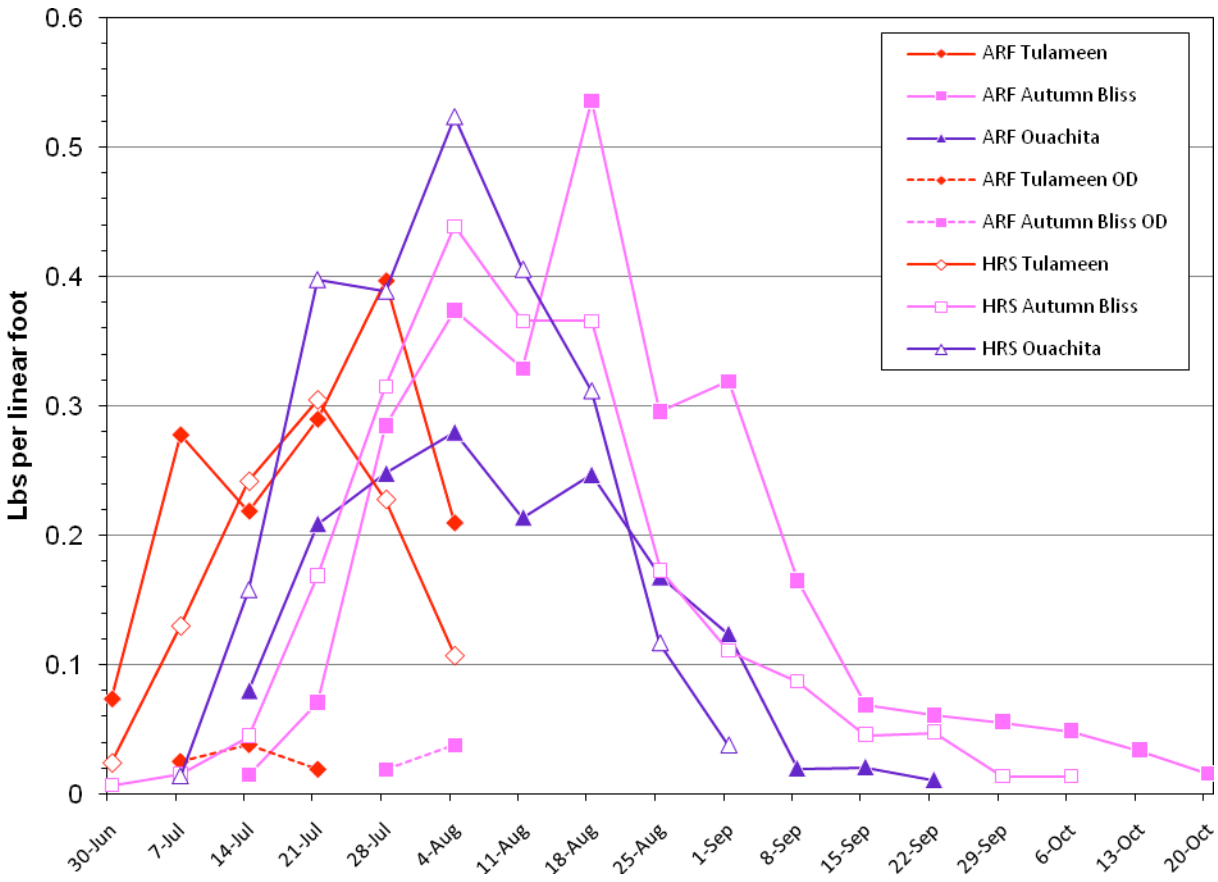


**Figure 1. Weekly yield per linear foot of Tulameen and Autumn Bliss raspberries and Ouachita blackberry grown in a high tunnel and outdoors (OD) at the Armstrong Research Farm, and in a high tunnel at the Horticulture Research Station in 2008.**

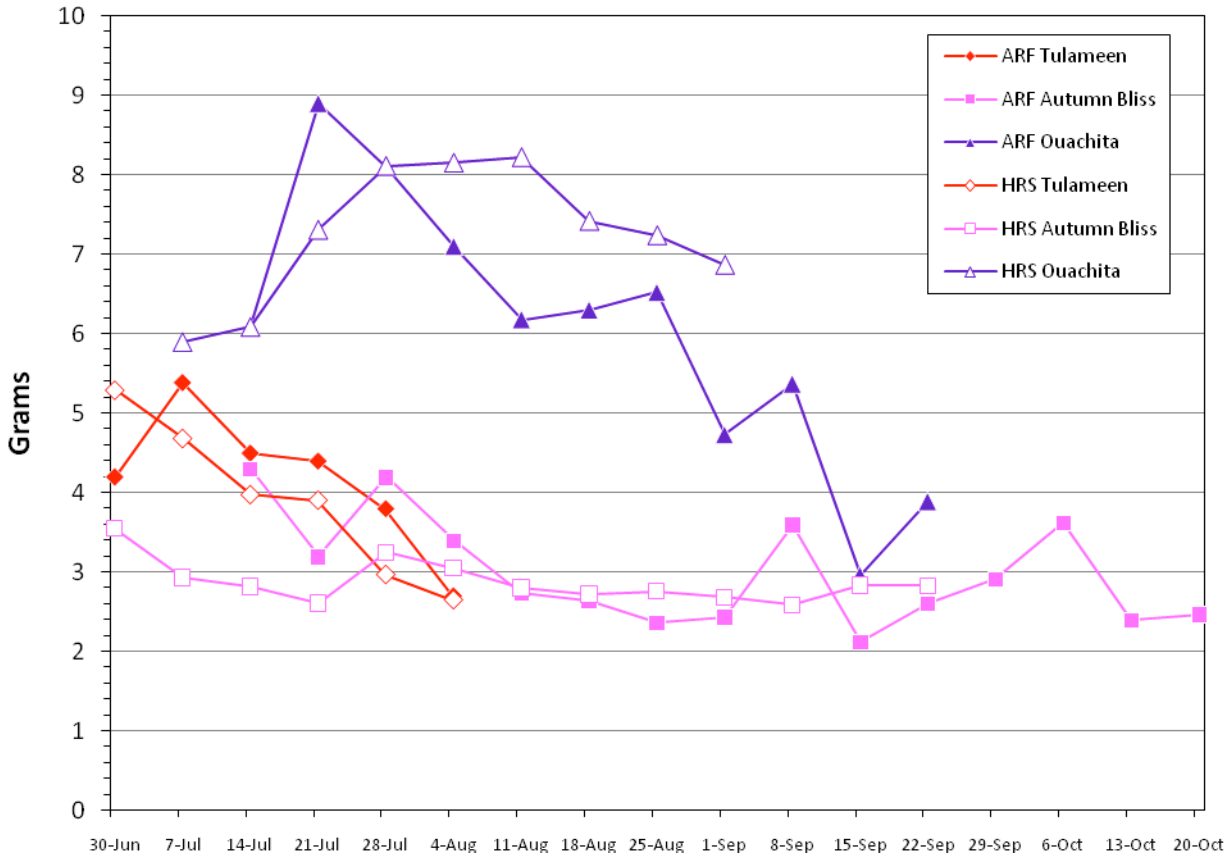


**Figure 2. Weekly average berry weight of Tulameen and Autumn Bliss raspberries, and Ouachita blackberry grown in a high tunnel at the Armstrong Research Farm (ARF) and Horticulture Research Station (HRS) in 2008.**

**Figure 3. Wind damage to the high tunnel at the Armstrong Research Farm on May 25, 2008.**

**Figure 4. *Botrytis* fruit rot on Autumn Bliss raspberry blossoms and developing fruit.**