High Tunnel Bramble Production

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Introduction

In 2006, a study was initiated at the ISU Armstrong Research Farm (ARF) 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 far enough ahead 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 2009 through 2011growing seasons.

Materials and Methods

In 2005, a 30 × 12 × 96 ft (W × H × L, 2,880 ft^2) high tunnel (FarmTek) with a 3-ft rafter spacing and roll-up side venting was acquired and erected at ARF 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

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 APF-45 (released in 2009 as Prime-Ark®45) in 2008.

During the winters, the tunnel was vented when inside temperature rose above 60°F and closed when outside temperatures were predicted to drop below 15°F. However, with no supplemental heat, the minimum temperatures inside a tunnel are very similar to the ambient air temperature. In mid-to-late December, Tulameen and Ouachita canes were laid down and covered for additional protection. The canes were covered with straw during the 2008–09 winter as practiced during previous winters. During the 2009–10 winter, straw plus spun-bonded polyester fabric (SBPF, Reemay) was used, and only SBPF was used during the 2010–11 winter. 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. For Autumn Bliss and Prime-Ark 45, all canes were cut off at the ground.

At or near April 1 of each year, the tunnel was allowed to warm up to begin the growing season. During the growing season, sides were rolled up to vent the tunnels when the inside temperature rose above 85°F, and closed when the inside temperature dropped below 65°F. Ouachita and Prime-Ark 45 primocanes were tipped when they reached a height of 18 and

36 in., respectively to induce lateral branching.

During the 2008 growing season, which was cooler than normal, *Botrytis* fruit rot and blossom blight was identified as a major disease problem in the side-vented tunnel. Beginning in 2009, fungicide sprays to control *Botrytis* were applied and once growing season temperatures warmed up, ventilation was improved by removing the south end wall and opening the top of the north end wall, and only closing them during periods of rain.

Results and Discussion

Berry yields from year to year varied between cultivars with Autumn Bliss being the most consistent and generally the most productive (Table 1). From year to year, production on Tulameen and Ouachita was variable, and in 2009 was the first year of production on Prime-Ark 45.

In previous years and in the years being reported, we have observed an early peak in production for Tulameen, Autumn Bliss, and Ouachita, followed by a sharp decline (Figures 1, 2 and 3). Year-to-year variations in yields between cultivars appear to have been affected by a combination of minimum winter temperatures and excessive heat in the tunnel during the growing season (Table 2). Ouachita, which is much less hardy than floricane red raspberries, had very low yields in 2010. The minimum temperature recorded on December 10, 2009 (-11^{o}F) occurred before the mulch was applied and seems to have caused injury to the canes and buds. Tulameen seems to have been hardy enough to withstand that freeze, and its very high production in 2010 can probably be attributed to the additional protection provided by the combination of the straw mulch covered with SBPF.

The duration of harvest for Tulameen, seems to have been affected by high temperatures, particularly during July (Table 2 and Figures 1-3). July 2009 had the fewest days of outside temperatures above 86^{o}F and the longest harvest period for Tulameen. July 2011 had the highest number of days above 86^{o}F and the shortest harvest period. Even with one end wall removed and the other vented at the top, temperatures inside the tunnel would rise well above the ambient air temperature on sunny days. This trend was not so evident for Autumn Bliss. The blackberries were generally more heat tolerant than raspberries.

In previous years, some very late season production has occurred on Autumn Bliss, but due to other activities going on at ARF, it has not been consistently recorded. In 2011, it was recorded and represented about 16 percent of the production (Figure 3).

Based on the past five years of data on growing red raspberries and blackberries in a high tunnel structure, our general conclusions are as follows:

1. Red raspberries and blackberries are viable crops for a high tunnel.
2. Production on primocane raspberries can be advanced enough that it eliminates the need to grow floricane types and providing winter protection.
3. Measures need to be taken to control *Botrytis* fruit rot and blossom blight. This would include fungicide sprays and good ventilation near the tops of tunnel structure to reduce the buildup of humidity at night.
4. Weeks of peak yield may saturate the market, but this could probably be remedied by planting a combination of early and later maturing cultivars.
5. Primocane blackberries will be a better alternative crop for high tunnels when less thorny, early season cultivars are developed.

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Table 1. Accumulated yield and average berry weight of Tulameen and Autumn Bliss raspberries, and Ouachita and APF-45 (Prime-Ark®45) blackberries grown in a high tunnel at the Armstrong Research Farm, Lewis, Iowa from 2009 through 2011.

	Accumulated yield								
	lb per linear foot[z]			lb/ft^2 of tunnel space[x]			Average berry wt (g)[z]		
Cultivar	2009	2010	2011	2009	2010	2011	2009	2010	2011
Raspberries:									
Tulameen	2.71 a	3.92 a	1.35 b	.42	.60	.21	2.9 c	3.4 c	3.1 b
Autumn Bliss	2.81 a	3.21 a	2.52 a	.43	.49	.39	3.1 c	3.9 bc	2.9 b
Blackberries:									
Ouachita	1.65 b	.52 c	1.64 b	.25	.08	.25	6.2 b	5.5 b	6.4 a
Prime-Ark 45	.72 b	1.70 b	1.32 b	.11	.26	.20	9.7 a	8.1 a	6.7 a

[z] Mean separation by Tukey's HSD (P=0.05). Means followed by the same letter are not significantly different.
[x] Based on a 6.5 ft row width.

Table 2. Minimum monthly ambient air temperatures during the winter months and number of days per month during the growing season that ambient air temperatures were recorded at or above 86°F at the Armstrong Research Farm, Lewis, Iowa.

	Minimum monthly temperature (°F)						Number of days per month temperature was at or above 86° F			
	2008-09		2009-10		2010-11					
Month	Temp	Date	Temp	Date	Temp	Date	Month	2009	2010	2011
November	6	21	20	30	12	25	May	1	3	3
December	-11	22	-11	10	-2	14	June	6	5	10
January	-20	15	-18	2	-8	13	July	1	10	22
February	-2	3	-13	9	-7	8	August	5	14	14
March	0	1	11	2	12	2	September	0	1	4

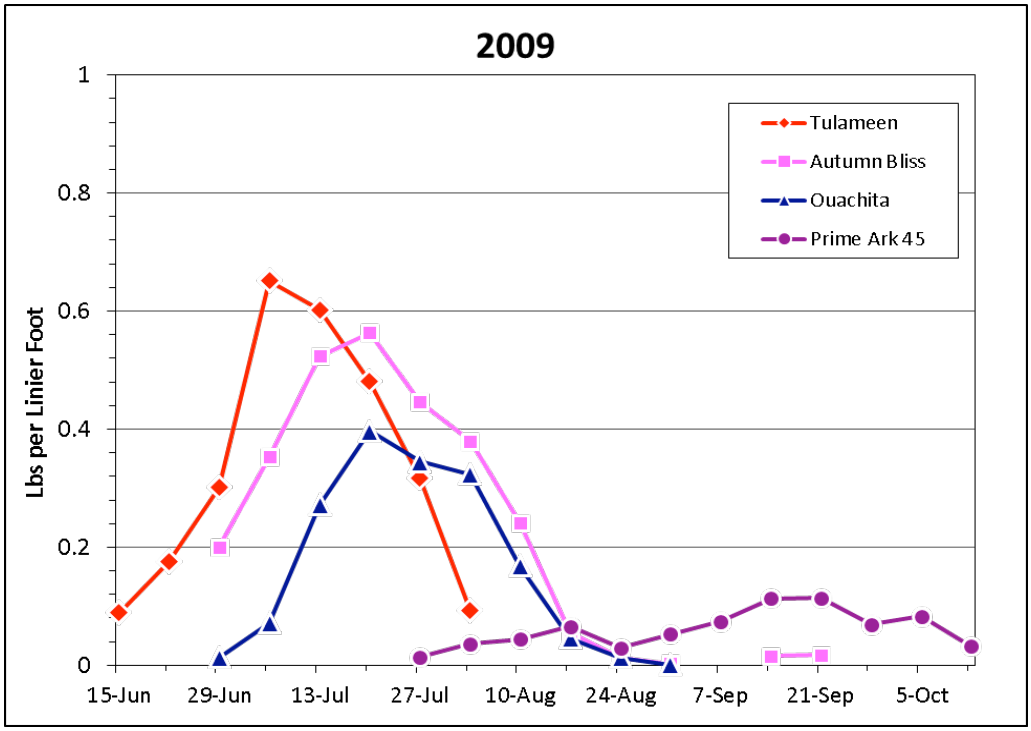

Figure 1. Weekly yield per linear foot of raspberry and blackberry cultivars grown in a high tunnel at the Armstrong Research Farm in 2009.

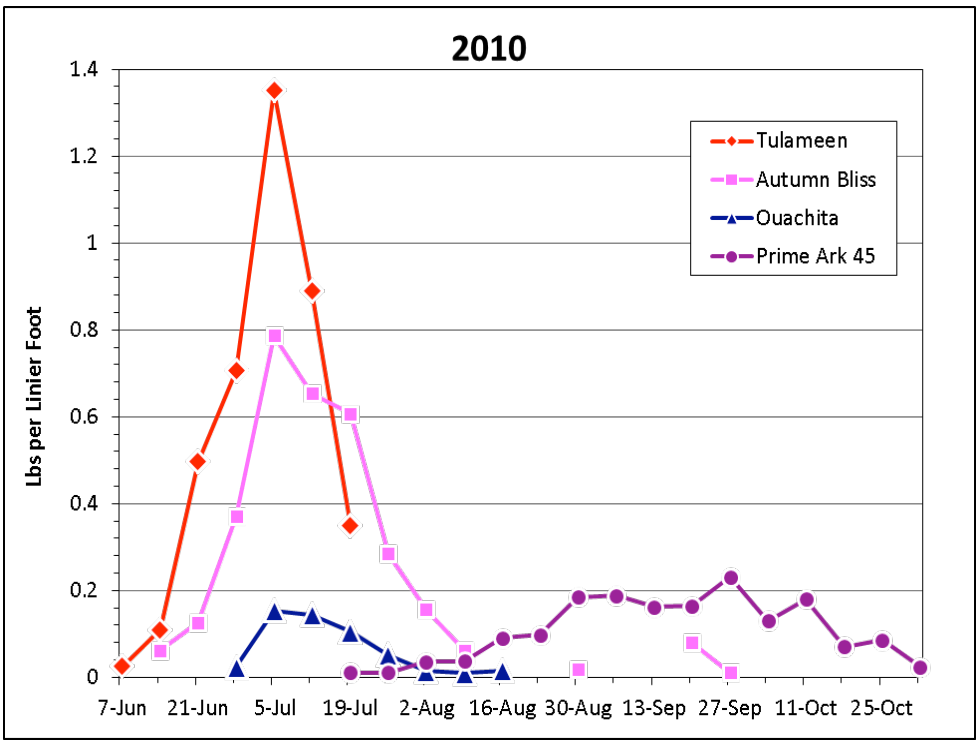

Figure 2. Weekly yield per linear foot of raspberry and blackberry cultivars grown in a high tunnel at the Armstrong Research Farm in 2010.

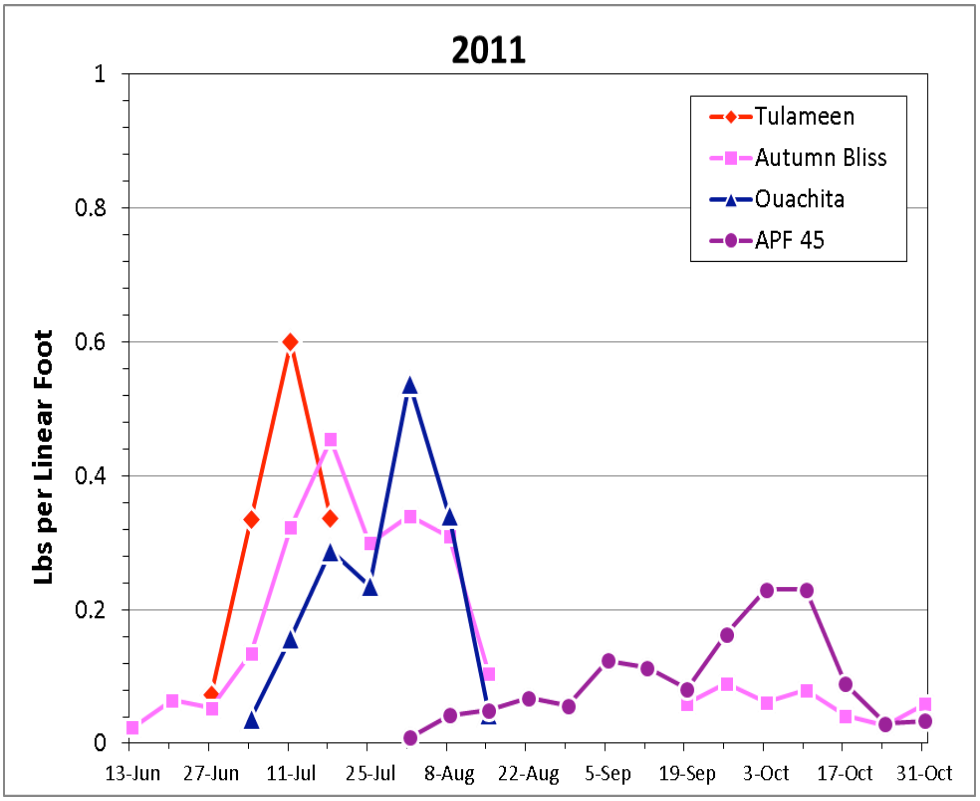

Figure 3. Weekly yield per linear foot of raspberry and blackberry cultivars grown in a high tunnel at the Armstrong Research Farm in 2011.