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High Tunnels for Earlier Production of Fall (primocane) Raspberries

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Introduction

Fall-bearing raspberries, also known as primocane-fruiting raspberries, are a popular option for Utah fruit producers. Cropping is not reliant on winter cane survival because they can fruit on first year canes. Canes can be cut to the ground at the end of each season to focus on a fall crop only, or can be double cropped in the fall and again in the summer by leaving canes for a second season. Focusing only on the fall crop simplifies pruning. Because of the simplified pruning and reduced concern of winter injury, producers in the colder, high-elevation areas of the state are interested in growing fall-bearing varieties. However, many fall-bearing raspberry varieties fruit late in the year, and do not provide a viable crop before their production is cut off by fall freeze events. If the production window of these raspberries could be shifted earlier in the year, more fruit could be harvested before fall freezes halt production. Additionally, shifting fall-bearing raspberries earlier in the year helps close the gap between the summer-bearing raspberry season and the normal fall-bearing season. Continuous production is desirable for some operations for marketing purposes. High tunnels are one option of advancing spring growth and moving production earlier.

A trial was conducted at the Utah State University research farm in North Logan, Utah, to determine the effectiveness of using high tunnels to advance spring growth and shift the harvest window of fall bearing raspberries. Two cultivars, 'Caroline' and 'Josephine' were planted in two replicate 2-season high tunnels (Figure 1) as well as comparison field plots. Two slightly different tunnel designs were used for the 2-season high tunnels: one was 14.5 ft wide x 10 ft tall x 45 ft long and the other was 17.5 ft wide x 9 ft tall x 45 ft long (Figure 1). The tunnels each had 1 row of 'Caroline' and 1 row of 'Josephine'. Rows were 42 ft long and 7 ft apart. During the 2016 and 2017 growing seasons, the tunnels were only covered with plastic in March and April and then covered with shade cloth during fruit ripening. Otherwise, the tunnels were left uncovered. From 2011 to 2015, the tunnels were managed to promote late fruiting (Maughan and Black, 2018). Tunnel structures represent significant initial costs, and labor for maintaining the tunnels and the protected crops require continued inputs. By only covering the raspberries for a specific short period, input costs were kept low while still realizing horticultural benefits.

Figure 1. A 2-season high tunnel (17.5 ft x 45 ft x 9 ft tall) over two rows of fall-bearing raspberries.

In-row weed control was a combination of annual pre-emergent herbicide and hand weeding. Plant nutrient needs were supplied with fertilizer applications through the drip irrigation system. Fertilizing was started in early June and continued at weekly intervals, with total season inputs of 120 lbs nitrogen per acre, 20 lbs phosphorus and 20 lbs potassium. If the plants appeared chlorotic, then a small amount of iron chelate was added to the fertilizer solution.

Research Results

Targeted spring high tunnel protection significantly advanced primocane growth over both seasons when compared with field-grown plants (Figure 2). Between cultivars, 'Caroline' had more pronounced early growth than Josephine. Table 1 compares the date high tunnel protected and field grown plants reached a cane height of 36 inches. This advanced cane growth corresponded with an earlier fruiting season (Figure 3).

Figure 2. Pictures of raspberry primocane growth were taken on the same day (May 3, 2017) under tunnel protection (left) and field conditions (right).

Table 1. Cane growth differences due to spring high tunnels, based on the date when average primocane height reached 36 inches.

		36 inch height (date)		
Year	Cultivar	Tunnel	Field	Dif.
2016	Caroline	28-May	25-Jun	28
	Josephine	19-Jun	21-Jun	2
2017	Caroline	19-May	30-Jun	42
	Josephine	6-Jun	2-Jul	26

The calculated harvest start date for 'Caroline' in tunnels was 30 July in both years, compared to 25 August for the field planting, a 26-day difference (Table 2). The season midpoint did not show the same level of advancement, with a 21-day difference between tunnel and field for 'Caroline'. This would indicate that harvest season progressed more quickly in the field than in the tunnels. The tunnels were covered with 30% shade cloth during ripening to reduce sunburned fruit (Figure 4). The shade cloth may have reduced heat accumulation enough to slow the progression of the harvest season.

In general, marketable fruit as a percentage of total yield was higher in the tunnels than in the field. There was a lower percentage of marketable fruit in 2017 than in 2016 due to a combination of increased insect pressure and accidental over-fertilization. Fruit were deemed unmarketable for a number of reasons including: soft or malformed fruit, sunburn (bleached drupelets), and damage from insects or disease. Sunburn is typically the most prevalent cause of unmarketable fruit under Utah conditions, and shade cloth application over the tunnels most likely contributed to the higher marketability percentage observed.

Table 2. The effect of a two-season high tunnel on harvest season of two fall-bearing raspberry cultivars, based on the beginning and midpoint of the harvest season.

		Harvest start			Season midpoint		
Year	Cultivar	Tunnel	Field	dif.	Tunnel	Field	dif.
2016	Caroline	30-Jul	25-Aug	26	25-Aug	14-Sep	20
	Josephine	6-Aug	28-Aug	22	3-Sep	18-Sep	15
2017	Caroline	30-Jul	25-Aug	26	22-Aug	12-Sep	21
	Josephine	8-Aug	26-Aug	18	28-Aug	15-Sep	18

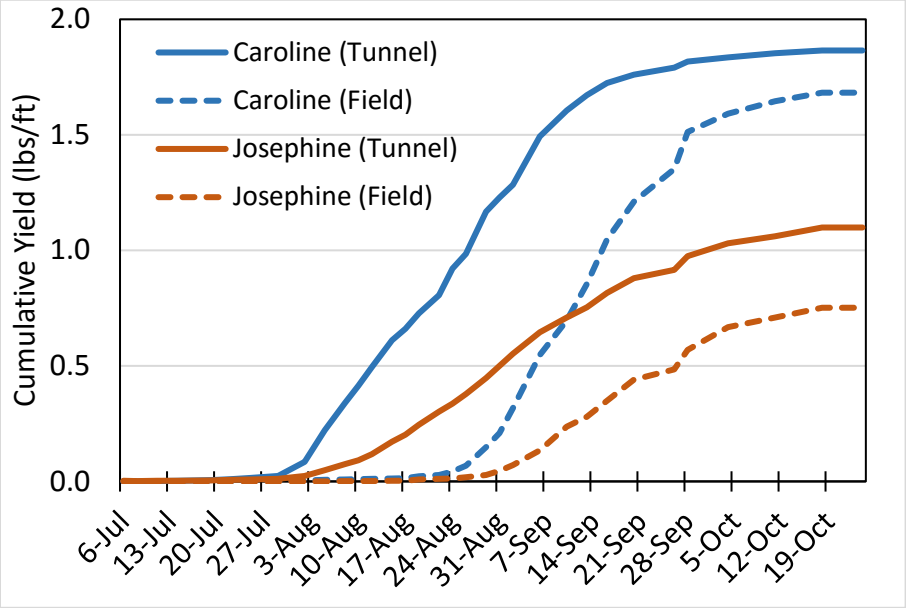

Figure 3. Cumulative yield of 'Caroline' and 'Josephine' raspberry in a two season tunnel and in the field during the 2016 season. Values are means of two replicate 42 foot long plots.


Figure 4. Shade cloth over high tunnel structure (background) and adjacent field-grown raspberries (foreground).

In both years, total yield under the tunnels tended to be higher than in the field for Caroline and Josephine, although the increase was not always statistically different. Between the two cultivars grown, 'Caroline' produced about 50% more fruit than 'Josephine' both in the tunnel and field. Individual berry size was greater in Josephine than Caroline and fruit size was not consistently affected by the tunnel.

Economic Evaluation

While high tunnels moved the harvest season earlier in the year relative to field-grown fall-bearing plants, the increase in yield was only moderate. Earlier primocane fruit most likely will not sell at a price premium as it would overlap with summer-bearing fruit. However, continuous raspberry availability may be beneficial for customer retention. High tunnels represent additional material and management costs. Table 3 compares high tunnel and field-grown raspberries costs and returns for both of the cultivars in this trial. Although high tunnel 'Caroline' yields were slightly higher in the two seasons tested, the yield increase was not sufficient to offset the higher cost of constructing and maintaining a high tunnel. High tunnel and field-grown 'Josephine' plants had nearly the same returns. Cultivar selection is critical when making decisions about high tunnel production. As mentioned previously, the cultivars in this trial were originally selected for a late season high tunnel experiment. Earlier fruiting fall-bearing cultivars, such as 'Polana', may have different results and profitability. Fall freeze events have a large effect on net income. In years when a killing freeze halts production before the full yield potential is met, the season advancement of the tunnel is more beneficial than when fall freezes are late enough to allow complete harvest of the field fall crop. It should be noted that the Caroline plants reached their full yield potential long before the first fall freeze event.

Table 3. Field and High Tunnel Early Fall-bearing Raspberry Costs and Returns, 17' x 45' long tunnel for two cultivars. Quantity is the 2-year average marketable yield.

			Caroline				Josephine			
			High Tunnel		Field		High Tunnel		Field	
	Units	Price	Quantity	Total	Quantity	Total	Quantity	Total	Quantity	Total
Revenues										
Raspberries	Pints	$ 7.00	331	**$2,317**	304	**$2,128**	205	**$1,435**	146	**$1,022**
Operating Expenses										
Management Labor	Hours	$10.00	20	$ 200	14	$ 140	20	$ 200	14	$ 140
Harvest Labor	Per Pint	$ 1.40	331	$ 463	304	$ 426	205	$ 463	146	$ 426
Supplies				$ 250		$ 250		$ 250		$ 250
Fixed Expenses (Depreciation)										
High Tunnel										
Annual				$ 253		$ -		$ 253		$ -
Irrigation System Annual				$ 60		$ 60		$ 60		$ 60
Total Expenses				**$1,226**		**$ 876**		**$1,226**		**$ 876**
Net Income				**$1,091**		**$1,252**		**$ 385**		**$ 368**

Conclusion

For growers in high-elevation valleys that commonly see significant winter damage to summer-fruiting canes (floricanes), primocane-fruiting cultivars can be used to avoid this risk. Using simple, low-cost 2-season tunnels to modify early spring growth moves the production window earlier and may provide an economically viable method for raspberry growers in Utah, especially in areas prone to early fall freezes.

Additional Reading

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