



## High Tunnel Blackberry Production in Northern Utah

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### Introduction

High tunnels have been effective in extending the growing season for numerous crops in Utah. Blackberries can be grown under high tunnels as a method of frost protection and extending the season later into the fall. If extended yields are achieved, net income may be increased. To achieve desired production, it is important to properly prepare the selected planting site and correctly manage plant growth. Here we outline information on blackberry management techniques for high tunnels, as well as research results from a four year study where cultivars representing the four types of blackberries (trailing, semi-erect, erect and primocane bearing) were evaluated for high tunnel performance.

### Site Selection

Since high tunnels extend the growing season, it is important to ensure there is a year-round source for irrigation water near the site. High tunnels should be oriented parallel to the strongest prevailing winds. This will allow the end walls to withstand the strongest winds, reducing the chance of damage to the structure. If multiple tunnels are used at one site, enough space should be left between tunnels to minimize shading, and allow at least 8 hours of sunlight daily. This can be 10 to 15 feet between tunnels, depending on tunnel height.

### Soil

Blackberries require well-drained, deep soils to thrive. Avoid heavy clay soils as plants are at higher risk of developing [Phytophthora root](#) rot when drainage is poor. Also avoid sites that previously had solanaceous crops (tomatoes, peppers, eggplant), strawberries or other cane fruit, to reduce the risk of soil borne pathogens.

To determine if pre-plant soil amendments are needed, soil samples should be collected and analyzed before planting. The Utah State University Analytical Laboratory provides soil analysis and information on sampling procedures. Their information can be found at <http://www.usual.usu.edu>. Based on the soil analysis, recommended nutrients should be incorporated into the top 4 to 10 inches of soil. If possible, perennial weeds should be controlled the summer before planting.

### Classification

#### Fruiting Type

There are two fruiting types of blackberries: floricane and primocane. Floricane-fruiting blackberries bear fruit only on second-year canes. After fruiting, these canes are pruned out leaving the first-year canes to produce the next year. Primocane-fruiting blackberries produce fruit on first-year canes, an advantage in that the canes do not have to survive a winter. These types are pruned to the ground each year.

#### Growth Habit

Blackberries are classified by growth habit into three categories: trailing, semi-erect, and erect. Trailing types produce long thin canes that will grow along the ground unless supported by an appropriate trellis. Semi-erect blackberries have primocanes that initially grow erect, but then branch and the side branches droop down to the ground. Erect blackberries are mostly self-supporting plants but still benefit from trellising.

For more detailed information on fruiting types and growth habits of blackberries reference our Blackberry Management Guide.

## How to Grow

### Spacing

Rows should be 6 to 9 feet apart, with plants spaced at least 3 to 6 feet apart in the row, depending on cultivar. This is closer than typically used in field production, to better utilize the high-value tunnel space. However, closer row spacing will require more vigilant cane training. Keep this spacing in mind during high tunnel selection. There are many different sizes and styles of high tunnel. For blackberry production, choose one that will be large enough to accommodate the desired number of plants, and taller canes.

### Irrigation

Blackberries have shallow, fibrous root systems that require regular irrigation. Inconsistent irrigation results in low primocane vigor, reduced fruit set, and poor fruit quality. Sprinkler irrigation is not recommended for high tunnel use because it increases moisture levels on canes and fruit, resulting in increased foliar and fruit disease incidence. Drip irrigation will reduce water use and keep humidity levels lower by applying water only where it is needed. Additionally, drip irrigation can minimize weed pressure since water is less available to weeds in the rows of the tunnel. Temperatures in high tunnels are normally higher than outside and soil moisture should be monitored closely to ensure plants have enough water. Find more information about measuring soil moisture content and blackberry irrigation requirements in our [Caneberry Irrigation](#) fact sheet.

### Fertilizer

Fertilizer requirements are typically very low in the establishment year. After establishment, nitrogen is one of the most limiting nutrients for blackberries, and quantity needed should be determined according to shoot growth. A general recommendation for an established planting is to apply 3 to 5 pounds of a balanced fertilizer, such as a 12-12-12, per 100 row feet. Apply fertilizer in the early spring. Fertigation is commonly used with drip irrigation systems to allow fertilizer applications throughout the growing season.

## Care and Management

### Pruning

Blackberry plants have a perennial root system with biennial canes, meaning the root systems can live for many years, while the individual canes live only 2 years. Old canes need to be pruned each year. Depending on the cultivar and plant vigor, summer pruning or thinning may also be needed.

### Pruning (Floricanes-fruiting)

Floricanes-fruiting blackberries bear fruit on second year canes and then that cane dies. Pruning out old canes is critical to keep plants healthy and manageable. Each

winter, remove dead or weak wood and spent floricanes, cutting them back to the crown. Tipping primocanes in the summer, when they reach a height of about 3 to 4 feet will help keep growth manageable for harvest, encourage branching, and cause lower branches to thicken and better support fruit. Thinning young floricanes to 3 to 4 canes per foot of row will also increase productivity.

### Pruning (Primocane-fruiting)

Primocane-fruiting blackberries will fruit on current year's growth during the late summer and fall. Allow canes to grow to 3 feet long and then tip (pinch off the top 2 inches of the cane) in early summer. This will encourage branching and increase bud formation. Once the canes die after hard winter freezes, remove all canes down to the ground. One major advantage of primocane-fruiting blackberries is that winter hardiness of the canes does not matter since they are all removed for the winter.

### Trellising

See our [Blackberry Management](#) fact sheet for more information about trellising and growth habits. With any of the three blackberry types, trellis systems are a good way to control cane growth, keep fruit off of the ground, and make berries more accessible for harvest. As space is very valuable within a high tunnel, select trellising systems that will not take up excessive space. T-trellises with support wires (Image 1) are a good option for high tunnel production.

### High Tunnel Temperature

Temperature management is an important component of high tunnel production. High tunnel air temperature can



Image 1. Blackberry T-trellis.

be as much as 30°F warmer than outside air Image 1. temperatures, while night temperatures can be as cold as temperatures outside of the tunnel. Ventilation is critical on sunny days, even during the winter. Opening vents, doors, or lifting up the side plastic can ventilate the tunnel, see Image 2. On very sunny days, high tunnels can require ventilation even when outside air temperatures are just above freezing.

The two approaches to high tunnel blackberry production are a 2-season or a 4-season tunnel. A 2-season tunnel only has plastic covering the tunnel from early fall to mid-winter. This approach is used solely for providing protection from fall freezes that would stop production and thus they extend the season farther into the year. A 4-season tunnel is covered year-round and is used for fall protection as in the 2-season tunnel, as well as for extreme winter and early spring freezes.

There may be some benefit to pushing earlier spring growth in primocane-bearing varieties to bring them into production earlier. However, in the trials done in Logan, UT no benefit of pushing floricanes to produce earlier in the spring was observed. The more effective approach has been using the high tunnel to keep flowers and fruit from freezing in the fall.



Image 2. Side-walls lifted to provide increased ventilation.

When using a 4-season tunnel, rather than try to achieve optimum growing temperatures in the spring, use the high tunnel in the spring to keep temperatures above freezing. When night temperatures consistently remain above 50°F, side doors should remain open, high tunnel plastic should be removed and/or 30% shade cloth should be placed over the tunnel to keep temperatures in

the optimum range of 75 to 85°F as much as possible, and avoid temperatures above 95°F.

In the early fall, some blackberry types (both the late-fruited semi-erect types and the primocane-bearing types) will still be producing flowers and fruit when freezing temperatures begin. For both 2 and 4-season tunnels, extend the harvest season further by using floating row covers or frost blankets applied inside the tunnel. Expect an additional 1 to 4°F above normal tunnel temperatures with each additional layer of protection. Aim to keep air temperature as close to the optimum temperature range as possible. Once plants have gone dormant, high tunnel plastic should be removed if using the 2-season method. Snow cover provides insulation that can be effective protection from severe freezing temperatures.

For the 4-season tunnel, moderate freezing temperatures inside the tunnel will not damage the plants. However, temperatures below -10 to -20°F (depending on cultivar) should be avoided to minimize cane loss from winter cold damage. If the weather forecast calls for extreme cold temperatures, use of temporary propane heating or secondary covers. Be sure to provide adequate ventilation during the day. Extreme temperature variation from day to night can be damaging to the plants. For more about temperature management in tunnels see [extension.usu.edu/productionhort/htm/tunnels](http://extension.usu.edu/productionhort/htm/tunnels).

### Pests

To avoid pest problems, a healthy environment needs to be maintained. Just as desirable plants can flourish inside a high tunnel, weeds and insect pests can thrive as well. Carefully controlling weeds inside and outside the tunnel will reduce the likelihood of insect and disease occurrences. Application of glyphosate or other systemic herbicides can be used to control perennial weeds during site preparation prior to planting, but use is much more difficult once the blackberries have been planted. Before tunnel construction, cover crops can be grown during the year prior to planting to reduce weed populations.

Integrated pest management (IPM) uses several management practices (monitoring, biological, cultural, and chemical controls) as a method for safe and economical pest control. Proper identification and monitoring will narrow the chances of unnecessary pesticide use and help determine the appropriate control strategy. Chemicals should be used only in cases of severe plant damage where biological and cultural controls were unsuccessful. Chemical controls can be used in high tunnels as long as they are labeled for greenhouse use. It is important to follow the label and wear appropriate personal protective equipment. A table of common blackberry pests is below.

<b>Insect</b>	<b>Identification</b>	<b>Control</b>
Larger Raspberry Aphid <i>Amphorophora agathonica</i>	Soft-bodied, fluid sucking insects that deplete plant nutrients, stunt vegetative and fruit growth and can spread diseases. Overwinters as eggs on canes. Many generations per year.	Monitor closely, checking under leaves. Encourage beneficial insects (such as lady beetles) and avoid applying pesticides that will damage them. Insecticidal soaps or oils should be used if plant health declines.
Dryberry Mite <i>Phyllocoptes gracilis</i>	Tiny, yellow/brown mites feed on undersides of leaves and cause yellow blotching. Often confused with sunscald symptoms. Overwinter in buds.	Predator mites are effective natural controls. Apply lime sulfur in spring when buds are about 0.5 inches long and again in the fall.
Redberry Mite <i>Acalitus essigi</i>	Very tiny mites (20-30x mag. needed to see) overwinter within buds or under bud scales. Feed on developing fruit during summer. Produce a toxin that prevents ripening and drupelets stay hard, red or green.	Apply wettable sulfur after buds swell but before buds open. Or apply horticultural oil at 1-2% by volume when fruit are in green to first pink stage. Do not apply sulfur or oil within 30 days or each other. Apply in the evening during bloom to avoid contact with bees.
Raspberry Crown Borer <i>Pennisetia marginata</i>	Adults are clear winged moths that look like a yellow jacket. Larvae are white with a brown head. Larvae borer into canes and reduce cane vigor or cause breakage at base of the cane.	Maintain by removing and burning of infested canes. For commercial use only: Bifenthrin, Chlorantraniliprole, or Diazinon should be applied before bud break and watered into the root zone.
<b>Disease</b>	<b>Identification</b>	<b>Control</b>
Grey Mold <i>Botrytis cinerea</i>	Gray fuzz and rot will develop from cool wet conditions on plants.	Avoiding over-irrigation and sprinkler irrigation to minimize humidity will prevent moisture accumulation on plants and decrease disease occurrence.
Phytophthora Root Rot <i>Phytophthora</i> spp.	A fungus that stunts and weakens plant growth and can make blackberries more susceptible to winter injury.	Good drainage, water management and crop rotations are some of the best control methods. Fungicides approved for blackberries should be appropriately used, but not relied on for control.
Sunscald	Fruit can be damaged by excess heat. The result is dried drupelets that turn brown while unaffected drupelets continue to mature.	Applying a 10-30% shade cloth will minimize sunscald.



Image 3. Blackberry fruit.

## Research Results

### Variety Trials

Several varieties of blackberries were grown in a high tunnel in North Logan, UT to determine yield performance and season extension. Blackberries are classified into four general growth habits: primocane bearing, trailing, semi-erect, and erect. Each growth habit has a slightly different production window. Over the 4 years tested, the trailing types came on first, closely followed by semi-erect. The erect types typically start a few weeks later than semi-erect with primocane-bearing cultivars coming on last, sometimes by as much as 2 months later than the trailing types. Figure 1 shows the production season for the best performing cultivar from each type during a representative year.

The primocane varieties used in this study did not reach their production peak before freezing, and overall

production was low. Trailing varieties are the least cold hardy of the four blackberry types. Their performance was reduced by winter cane damage. Although the tunnels remained covered throughout the winter, there was still significant cane damage in less hardy cultivars. Semi-erect and erect varieties have upright growth and are hardier than trailing types. Both semi-erect and erect varieties performed fairly well in a high tunnel, with some differences among cultivars (Table 1).

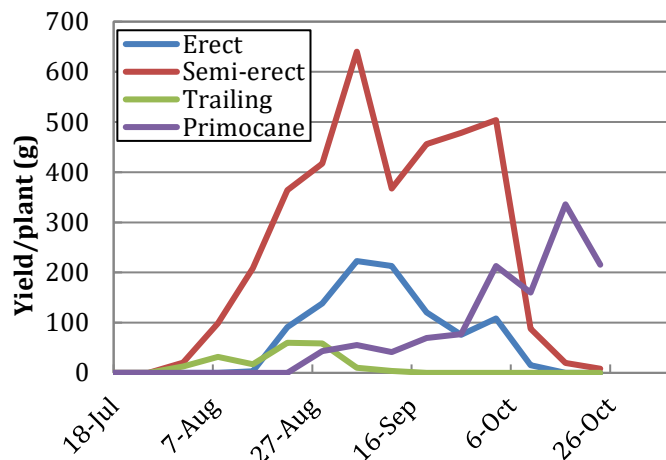


Figure 1. Time course of each growth type in 2011. The best performing cultivar from each type is shown. They are Navaho, Lochness, Metolius, and Prime Jan.

**Table 1. Total seasonal yield (lbs/plant) by cultivar over 4 years.**

Type	Cultivar	2009	2010	2011	2012	4 yr Avg.
Primocane	Prime-Ark 45	0.0	0.0	0.1	2.0	0.5
Primocane	Prime Jan	1.0	0.3	1.5	4.1	1.7
Primocane	Prine Jim	0.6	0.7	6.2	2.8	2.6
Trailing	Metolius	1.6	0.8	1.5	3.7	1.9
Trailing	ORUS 1939-4	0.3	0.3	0.4	0.9	0.5
Trailing	Siskyou	0.0	0.2	0.1	0.5	0.2
Semi-erect	Chester	5.7	7.8	12.3	23.0	12.2
Semi-erect	Hull	7.3	15.7	0.6	24.1	11.9
Semi-erect	Lochness	3.9	7.7	8.1	11.4	7.8
Erect	Apache	0.1	0.6	0.6	2.4	0.9
Erect	Arapaho	3.8	1.9	1.3	1.9	2.2
Erect	Navaho	10.3	5.8	2.2	8.4	6.6

## Conclusion

Trailing blackberries are not recommended for high tunnel production in Northern Utah due to low winter cane survival. Semi-erect and erect types were successful in the high tunnel, with ‘Chester,’ ‘Hull’ (semi-erect), and ‘Navaho’ (erect) having the best overall yield. Selective thinning of primocanes is recommended for ‘Hull’ to help prevent biennial bearing as seen in Table 1. Primocane-bearing varieties were not able to reach full production before a killing fall-frost occurred in all 4 years. In a climate warmer than Logan, UT primocanes-bearing blackberries may be more successful.

Trying to use high tunnels to push floriculture production earlier in the season has been ineffective in Logan, UT. However, using high tunnels to extend production of late-fruiting varieties farther into the fall has proven more effective. Rather than reducing winter injury, plants inside the high tunnels showed as high or higher winter cane damage than field-grown plants. This is due to large temperature fluctuations inside the tunnel during the winter. These fluctuations are very damaging to blackberries, even more so than typical cold winter temperatures. Depending on the climate, it may be more beneficial to completely remove the plastic after fruiting ceases in the winter and to replace it once temperatures begin to decrease in the following fall (2-season approach).

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