Raspberries in High Tunnels: Opportunities and Challenges

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High tunnel raspberry production offers several advantages over field production, such as an extended growing season, improved fruit quality, and decreased occurrence of certain problematic diseases such as gray mold. However, the high tunnel environment also presents some new challenges. These challenges include the type and intensity of pest occurrences, issues surrounding fertilizer and water use, soil health, and finding time to manage the tunnels. Some challenges are crosses between those typically faced in greenhouse vs. field production.

Most growers with high tunnel raspberries in the northeastern U.S. are using single-bay tunnels, usually covered for all 4 seasons - thus they are the focus of this presentation. Tunnel effects are generally more pronounced in these types of tunnels as compared to 3-season tunnels where plastic is removed for the winter and the tunnels are fully vented by gathering the plastic during high wind events or during very hot weather.

It helps to understand what effects the tunnel has on the environment, and the results of these effects. In tunnels, air temperatures are warmer overall, being milder in winter, sufficiently warm to sustain growth in spring and fall, and sometimes very hot in the summer. Soil temperatures are also warmer, and the soil is less likely to freeze deeply over the winter. Placement and amount of water is controlled, so there is no moisture on leaves from rain or overhead irrigation. Relative humidity is higher in the tunnel, and there can be moisture present on the leaves from condensation when the tunnel is closed.

The temperature changes result in a longer growing season. Tunnel use adds at least 3 to 4 weeks to both the beginning and end of the growing season. This means that we can grow varieties of raspberries that require a longer growing season than we have in the field. These could be primocane-bearing cultivars that have improved or unique flavor and size. Because plants start growing earlier in the spring, summer-bearers fruit earlier thus allowing growers to capture the early market. The longer growing season means that plants have time to grow larger, and yields are higher, typically at least 2 to 3 times that expected from field production. These higher yields result in (hopefully) higher sales and increased potential for profits. With a sufficiently long growing season, we can tip primocane-fruiting plants to stagger the production season of an individual cultivar.

The increased plant growth, however, results in some challenges. Large high-yielding plants remove more nutrients from the soil, so requirements for certain nutrients such as potassium are thought to be higher in tunnels than in the field. Very little work has been done to work out fertilizer and water requirements to optimize raspberry growth long-term in tunnels. Bramble fruit has a relatively high potassium content – roughly equal to that of nitrogen, and the concentration of both are much higher than that of other macronutrients such as phosphorus, calcium, and magnesium. Upon occasion, we've run into potassium deficiencies that have been difficult to correct. We now recommend applying fertilizers balanced in nitrogen and potassium such as a 20-10-20 with micronutrients, rather than applying only nitrogen yearly as in the field, and conducting tissue tests yearly to stay on top of potential problems regardless of nutrient

source used. Counteracting the large amounts of fruit and biomass removal, however, is the fact that leaching of nutrients is likely to be very low. Compost can also be used as a nutrient source, but at this point, the dynamics of nutrient release from organic sources in a tunnel are not characterized. Higher soil temperatures could result in higher mineralization rates.

Because the tunnel roof protects the plants from rainfall, the only water applied is through the irrigation system. This has both some advantages and disadvantages. Within the area of disease management, because leaf wetness is reduced, fungal sporulation of most diseases is reduced. Some of the diseases that result in crop loss in field production such gray mold or anthracnose are greatly reduced, and therefore shelf life is also often greatly improved. Powdery mildew, however, is an exception since it is worse under conditions of high humidity and reduced leaf wetness. It can be a problem in high tunnel raspberry production, though rarely problematic in field production. Good air flow through the tunnel should be maintained whenever possible.

The change in leaf wetness also affects insects and mites. Those pests that are problematic in greenhouses, such as whiteflies, aphids, and thrips are commonly greater problems in high tunnel production than they are in the field. Aphids and thrips are problematic even at low levels due to the potential for virus transmission, and two-spotted spider mites are frequently identified as the greatest problem in high tunnel raspberry production. The combination of dry conditions and warm temperatures can increase the number of pest generations per year for certain pests. Finally, soil- and crown-dwelling insects can be an issue, perhaps because the milder soil temperatures over the winter allow them to either be protected, or to continue to multiply year-round. Crown borers have been a problem in blackberries, but not in primocane-bearing raspberries, perhaps because the removal of the canes each year disrupts their life cycle. Ants prefer the dry environment, and can be problematic on the foliage, especially if aphids or other honeydew-excreting insects are present, and they end up in harvest containers.

Fortunately, biocontrol agents such as predatory mites, ladybird beetles, and lacewings have established and worked quite well in tunnels, and some pests have been manageable with softer pesticides. This results in the increased feasibility of organic raspberry production in tunnels compared to the field.

With water application being dependent on the irrigation source, water quality takes on added importance in a tunnel. Water high in calcium and magnesium or other elements can result in imbalances in nutrients, cause the soil pH to change, or cause precipitation of soluble fertilizers. It is recommended that the water source be tested, and treatment such as acidification used if necessary. Also, the fact that the tunnel roof remains over the winter means that there is no opportunity for salts from either synthetic fertilizers or composts to be leached. While less of a problem with raspberries due to their relatively deep root systems, this has been an issue with crops such as strawberries that are extremely salt sensitive, or when salts are incorporated during tillage operations prior to a subsequent crop. This situation appears to be quite easily rectified by leaving a tunnel roof off for the winter in years when plastic needs to be replaced anyway, but early season benefits are likely to be nonexistent in that particular year.

When profits for high tunnel crops are compared, the big winner appears to be tomatoes - raspberries fare well in the comparison, but still are in second place at best. Most growers report pay-off of the tunnel in either the second or third year with raspberry production. The big factors for long-term profits are yield, the price received, and the cost of labor for harvest. Good yields (10,000 lb/a equivalent or higher), a decent price received ($2.50 per half-pint or higher), and minimizing harvest costs ($0.50/half-pint or less) result in good potential for very significant profits.