**Title:** Can we use long cane raspberries to advance the season of raspberry production in the southern United States? Phase II. Harvest and post harvest evaluation

**Report**

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**Objective:**
The objective of this proposal was to determine if raspberry harvest season can be advanced in warmer regions of the southern U.S. using long cane nursery plants.

**Justification and Description**
Since 1985, the NC State University raspberry breeding program had relied on traditional methods for developing cultivars adapted to the southeastern United States. Although this process has been successful with the release of 'Nantahala', we are aware that some growers are unable to produce fruit in their area using *cultivars that are currently available*.

For many years, growers in Europe have utilized a method of producing high quality raspberry fruit using nursery plants grown in either pots or nursery (spawn) beds in a cool location; these plants are then shipped to a second location for fruit production. This practice is called long cane raspberry production. In long cane raspberry production, fruit bud formation and rest requirements are satisfied in the high/cool elevation nursery, either naturally or during a period of cold storage. Then fruit production occurs in warmer location, usually a high tunnel or greenhouse located in a warmer climate. This system is utilized to produce fruit in southern Spain, where fruit can come into production in early March and growers are able to sell fruit at a premium price in the early market window. The system is also used in England with tunnels during the off season (Gillespie et al.)

We evaluated a similar system for raspberry production in the southern region of the US. We have high elevation nurseries in the Appalachian Mountains where there are climate conditions that will produce quality long cane plants with adequate chilling requirements. We also have

regions in the southern U.S. that have temperatures in the spring that are optimal for raspberry production.

**Methodologies**

*Long cane production*
Long cane plants of ten cultivars and advanced selections were grown at the Upper Mountain Research Station, Laurel Springs, NC (lat. 36° 23' 60" N, long. 86°17' 24" W, elevation 867 m) from May 2012 until February/March 2013.

Potted plants. In the summer of 2012, twenty plants each of floricane-fruiting 'Tulameen' and NC 548 were grown in 5 gallon pots in a Fafard 4P (Sun Gro Agriculture, Agawam MA) commercial potting soil. Plants were watered with a drip system as needed on a daily basis and a complete 20-10-20 fertilizer at a rate of 17.5 ppm was added on a weekly basis. Three primocanes were allowed to grow in each pot. Additional emerging primocanes were removed on a biweekly basis. (Figure 1). Chilling hours were calculated based on ambient temperatures collected by the State Climate Office of North Carolina, 2013. Plants have received 889 chilling hours by Feb 7 and 1299 hours by March 21. Plants produced using this system are hereafter referred to as floricane-fruiting potted plants (FFPP).

Field grown nursery plants. In this system, 2 sets of long canes of 4 floricane- and 4 primocane-fruiting cultivars and advanced selections were produced in nursery (spawn) beds in the field. When the canes were matured and dormant in the fall, plants with 3-4 canes were dug from the beds with intact roots and placed in large plastic bags and put into cold storage at 40°F on November 7 (Figure 2). Chilling hours were calculated based on the standard number of hours accumulated between 35-45°F. The long canes are brought out of the cold storage on February 7 and March 21 when they had accumulated 2208 and 3216 chilling hours and transferred to the high tunnels at the Sandhills Research Station (Figure 3). The plants were set into 3 gallon pots filled with Fafard 4P potting soil. Plants produced using this system are hereafter referred to as floricane-fruiting nursery dug plants (FFNP) and primocane-fruiting nursery dug plants (PFNP).

*Fruit production*
During the spring and summer of 2013, three fruiting trials were conducted at the Sandhills Research Station in Jackson Springs NC (lat. 35°18' N long 79°68' W, elevation 190 m). All plants were grown in a Rimol 30' X 48' NOR'EASTER GH (Rimol Greenhouse systems, Hooksett, NH) during the spring and summer of 2014 (Figure 4). The tunnel was equipped with a thermostat and motor kit that opened the gable vents when the temperature reached 80 and side vents when temperatures were higher than 88. Temperatures were monitored inside and outside of the tunnel throughout the trial using Watchdog B series Button loggers (Spectrum Technologies Aurora IL) (Figure 5).

Plants transferred from the UMRS to SRS on February 7 and March 21 in a minivan and placed in the high tunnel. Each pots was supplied with water through a drip irrigation system. Plants were watered with a drip system as needed on a daily basis and a complete 20-10-20 fertilizer at a rate of 17.5 ppm was added on a weekly basis.

*Types of plants produced*
Floricane fruiting potted plants (FFPP) were set in a randomized block design in 2 rows consisting of 4 replications of 5 plant plots. Each row consisted of plants introduced to the greenhouse in February 7th and March 21st respectively.

Floricane-fruiting nursery plants Moutere (FFNP), NC 344, NC 612 and Octavia, were set in 2 rows in 2 replications of 2 plants. Each row consisted of plants introduced to the greenhouse in February 7th and March 21st respectively.

Primocane fruiting nursery plants (PFNP) Autumn Britten, Caroline, Himbo Top and Nantahala, were set in 2 rows in 2 replications of 2 plants. Each row consisted of plants introduced to the greenhouse in February 7th and March 21st respectively.

**Results/Conclusions**

The results using the above systems have been mixed. In general, nursery grown plants produced more fruit than plants grown in pots (Tables 1-3). Date of transfer (February or March) had no statistical impact on yield (data not shown).

There were no treatment differences among cultivars or date of transfer for FFNP (Table 1). Moutere had the highest yield and Octavia had the largest berries, although neither was statistically significant. Harvest season was not earlier in the tunnel than in adjacent plants in the field (personal observation).

The plants in the group PFNP had the highest yields of the three plant groups. Autumn Britten had the highest total yield and berry size among the 4 cultivars in this treatment. Harvest season was not earlier than plants grown in adjacent fields (personal observation).

Although the FFPP were predicted to have the highest yields, this group of plants had very low total and marketable yields. Harvest dates were not earlier than field grown plants.

Although data was not collected for bud break, we observed many canes had blind buds. This condition is often a result of insufficient chilling, however, the minimum chlling any of the treatment received was 888 hours and the maximum chilling was 3216. Although plants were grown in higher elevation in the western NC Mountains, growing conditions were not optimal. The summer of 2012 was very hot, cane vigor although not measured was observed to be low and high temperatures may have impacted floral bud development.

In the past 2 years we have seen Spotted Wing Drosophila become a significant pest in raspberries everywhere in the US. In NC and other parts of the SE, we see the levels of infestation rise at the end of the summer. We are hopeful that the early season production of raspberries in this system will help avoid the infestation rates we see later in the season.

**Impact Statement**

Production of fruit using potted raspberry plants in high tunnels was achieved when potted plants were grown in a tunnel in the early spring. However, treatments need to be refined to advance harvest date and increase yield in order for this system to economically viable.

**References**

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Figure 1. Floricane-fruiting potted plants at the UMRS summer 2012.

Figure 2. Nursery dug floricane and primocane fruiting long canes in coolers.

Figure 3. Dormant long canes, spring 2013.


Figure 4. Fruit production under high tunnel at the Sandhills Research Station, Jackson Springs NC, June 2013.

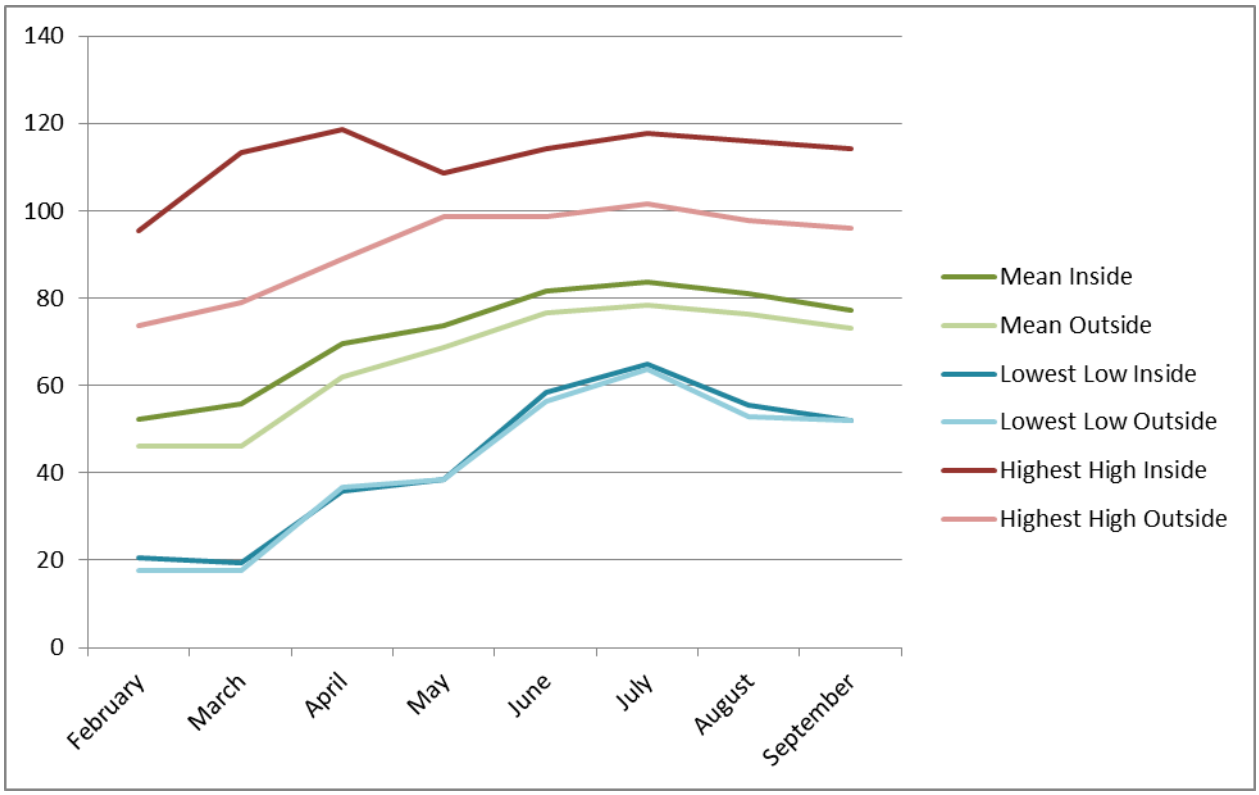


Figure 5. Monthly mean, lowest low and highest high temperature in and out of the tunnel Jackson Springs, NC for 2013 in degrees Fahrenheit.