Title: Vegetation-free Strip Width in Blackberry

Progress Report

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Research

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Objectives:
1) To determine the optimum vegetation-free strip width for established blackberry with regards to plant vigor, primocane thinning, yield, fruit quality, and income potential.

Justification and Description:

Blackberry production in the Southeastern United States has grown rapidly in recent years. Between 1997 and 2007 acreage and farm number have increased 132 and 211%, respectively (USDA-NASS 1998, 2008). Growth in the Southeast at that time exceeded national growth of 109 and 79% in farm number and acreage, respectively (USDA-NASS 1998, 2008). As of 2007 blackberry production in the Southeast consisted of 1,950 acres on 1,150 farms (USDA-NASS 2008). This production equaled 20 and 13% of the blackberry growing farms and acreage, respectively, in the United States (USDA-NASS 2008). With such rapid growth, cultural management practices, including those that pertain to field floor management, may vary greatly among growers and require further understanding.

Commercial blackberry production consists of planted rows and between row spaces. Management of the two spaces differs significantly. Areas within the planted row are often treated to remove or exclude weeds using organic or synthetic mulches and/or herbicides. Between row spaces often consist of existing vegetation and/or a sod strip. However, as the vegetation strip encroaches toward the weeded row, it can compete with the blackberry crop for water and nutrients. To limit interference of the vegetation strip, an optimal herbicide strip or vegetation-free strip width (VFSW) must be determined.

Two VFSW studies were initiated in 2011 at the Sandhills Research Station in Jackson Spring, N.C. to evaluate the influence of six VFSWs (0, 1, 2, 4, 6, and 8 ft) on 'Navaho' blackberry establishment and development (Steve L. Meyers Ph.D project). Strip widths were established in late summer-early fall and baseline data (primocane number, diameter, length) collected. Vegetation between rows consisted of existing weed species

(annual and perennial grasses, sandbur, yellow nutsedge, and broadleaf weeds). Plant growth parameters and fruit yield and quality parameters were measured in 2012.

Funding from SRSFC will be used to continue monitoring the studies at Sandhills Research Station (Master of Science project for Nick Basinger). Results from 2012 indicate that season-long blackberry yield in 2012 displayed a positive response to VFSW. As VFSW increased yield increased with the maximum yield occurring with a VFSW of 6 feet. Additionally, season-long individual fruit weight displayed a positive linear response to VFSW. Primocane number, length, and stem caliper in fall 2012 did not display a response to VFSW. It is likely over time as the ground cover is allowed to compete with the maturing blackberry crop that the relationship between the blackberry crop and the VFSW will change and results become more significant. This research would provide valuable information to growers in North Carolina and throughout the Southeast.

In September 2012 a grower location was identified in western NC and was added to the project to determine the relationship in a different environment (western NC). Grass seed (fescue) was planted in the row middles the week of October 29th and then the VFSW treatments established This study is part of a Master of Science thesis project for Nick Basinger, a student who began in January 2013.

Materials and Methods:

Field studies were initiated in 2011 at two locations at the Sandhills Research Station near Jackson Springs, NC to determine the influence of vegetation-free strip width (VFSW) on the growth of newly planted 'Navaho' blackberry plants, and the yield and quality of blackberry fruit. Soil at Location 1 consisted of Candor (sandy, siliceous, thermic Arenic Paleudults) and Fuquay sands (loamy, siliceous, thermic Arenic Plinthic Kandiudults). Soil at Location 2 was a Candor sand. Both locations had a field history consisting of sorghum-Sudangrass (*Sorghum* x *drummondii*) in 2009 and peanut (*Arachis hypogaea* L.) in 2010. A fall rye cover crop was planted on 10 Nov. 2010. Rye was killed on 8 Mar. 2011 with an application of glyphosate (Buccaneer Plus, Tenkoz, Inc., Alpharetta, GA) at 830 g acid equivalent ha^{-1}. 'Navaho' blackberry plugs (50 per flat) (North American Plants Inc., Lafayette, OR) were planted on 29 Mar. 2011 with in-row and between-row spacing of 1.2 and 3.7 m, respectively. Plots were maintained weed-free by shallow cultivation within 0.6 m of both sides of the planted row until 9 June 2011. A V-trellis was installed on 14 June 2011. VFSW treatments were established on 5 Aug. 2011 at Location 1 and 18 Oct. 2011 at Location 2. Between-row vegetation consisted of existing weed and turf-grass species and included Bermudagrass [*Cynodon dactylon* (L.) Pers.], carpetweed (*Mollugo verticillata* L.), cutleaf evening primrose (*Oenothera laciniata* Hill), horseweed [*Conyza canadensis* (L.) Cronquist], large crabgrass [*Digitaria sanguinalis* (L.) Scop.], long-spined sandbur [*Cenchrus longispinus* (Hack.) Fernald], spotted spurge [*Chamaesyce maculate* (L.) Small], volunteer peanut (*Arachis hypogaea* L.), and yellow nutsedge (*Cyperus esculentus* L.).

Treatments consisted of 0, 0.3, 0.6, 1.2, 1.8, and 2.4 m (0, 1, 2, 4, 6, and 8 feet) VFSW with half of each VFSW distributed on either side of the planted row. Plots consisted of four plants at Location 1 and three plants at Location 2. Vegetation-free strips were maintained weed-free with the applications of a paraquat (Gramoxone Inteon®, Syngenta Crop Protection, Inc., Greensboro, NC) solution of 5 g ai L^{-1} plus 0.25% v/v nonionic

surfactant or a glufosinate (Rely 280®, Bayer CropScience LP, Research Triangle Park, NC) solution of 8.4 g ai L^{-1}. On 12 July 2012, 310 g ha^{-1} sethoxydim (Poast®, BASF Corp., Research Triangle Park, NC) was applied to control emerged large crabgrass within the designated VFSW area at both locations. All herbicides were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 187 L ha^{-1} with a single 8003EVS nozzle tip (Teejet 8003EVS, Teejet® Technologies) at 140 kPa. All applications contained an inert blue spray indicator dye.

In Fall 2012 a third field study was established at Killdeer Farm near Kings Mountain, NC. On November 2, 2012 'Kentucky 31' fescue was planted beneath established three-year-old 'Navaho' blackberries. VFSW's of 0, 0.6, 0.9, 1.2 and 1.8 (0, 2, 3, 4, and 6 feet) were established on March 5, 2013 with an application of terbacil (Sinbar) at 0.5lb/A, plus paraquat at 2pt/A.

Data collected included primocane number, floricane weight (Sandhills location 1 and 2), yield, individual fruit weight, and cane length fruit pH, soluble solids content (SSC), and titratable acidity (TA).

At Jackson Springs Location 1 and 2, berries were harvested weekly from June 24 to July 22, 2013. Twenty-five berries of 'dull black' and 'shiny black' were removed from each plot during the first two harvests placed in a freezer at 0°C for fruit analysis. At final harvest on July 22, 2013, remaining unripe berries were counted multiplied by the mean berry weight over the season.

At Killdeer Farm, samples of 25 black berries for 'shiny black' were harvested on two dates and three dates for 'dull black.' These harvests occurred between June 25 and July 29, 2013. Unlike Sandhills, berries at Killdeer were counted prior to any harvest for the season. All berries were counted for 5 ft of row in each plot. The number of berries was multiplied by the mean berry weight over the season to determine yield potential.

Berry analysis took place in the small fruits lab at North Carolina State University. 'Dull black' and 'shiny black' berries were analyzed separately. On the day of analysis, berries were removed from the freezer and allowed to thaw at room temperature. Berries were then ground at 15,000 rpm (Brinkman Polytron PT 10-35) until berries became a homogenized puree. Soluble solids content (SSC) was determined by placing approximately 1g of puree on the stage of digital refractometer (Mettler Toledo Refracto 30P). For pH and Titratable acidity (TA) 2 g of puree was placed in 60 ml of deionized H_2O. A stir bar was placed in the bottom of the titration cup and then placed on a stir plate for 1 min. After the puree was mixed into solution pH was measured (Beckman Coulter pHi510, Orion 8156BNUWP Ross Ultra Combination pH meter). The titration cup was then placed on the titrator (Mettler Toledo DL15 Titrator) and titrated to an endpoint of pH 8.2 using 0.95N NaOH as the titrant. Titratable Acidity results were expressed in percent citric acid.

Data was subjected to ANOVA analysis by SAS PROC GLM (SAS 9.3, SAS Institute, Cary, NC). The experimental design was a randomized complete block with four replications.

Results:

Primocane number. Primocane number increased with increasing VFSW at all three locations (data not shown). This was expected as less competition is occurring from weedy vegetation as VFSW increased.

Floricane weight (data collected at Jackson Springs locations only). There was a significant location effect for floricane weight (data not shown). Canes removed from Jackson Springs Location 1 were greatest for the 0 VFSW. As VFSW increased floricane weight decreased for both locations at Jackson Springs.

Blackberry yield. Although yield between locations was significant, VFSW treatments (0, 0.3, 0.6, 1.2, 1.8, and 2.4 m) did not have an effect on yield (Figure 1). It is likely that water availability contributed to the lack of influence of VFSW on blackberry yield. Vegetation in a narrow VFSW would be expected to compete with the crop for water and nutrients. In 2013 the Jackson Springs location received 33 in of rain during the months of June and July. The average rainfall in Jackson Springs for June and July is 9 in. This significant rainfall likely reduced the competition between crop and between-row vegetation for this resource.

Blackberry fruit weight. Blackberry fruit weight decreased at Jackson Springs Location 1 and King's Mountain as VFSW increased. Although there was a numerical trend at Jackson Springs Location 2 for an increase in berry weight it was not significant (Figure 2).

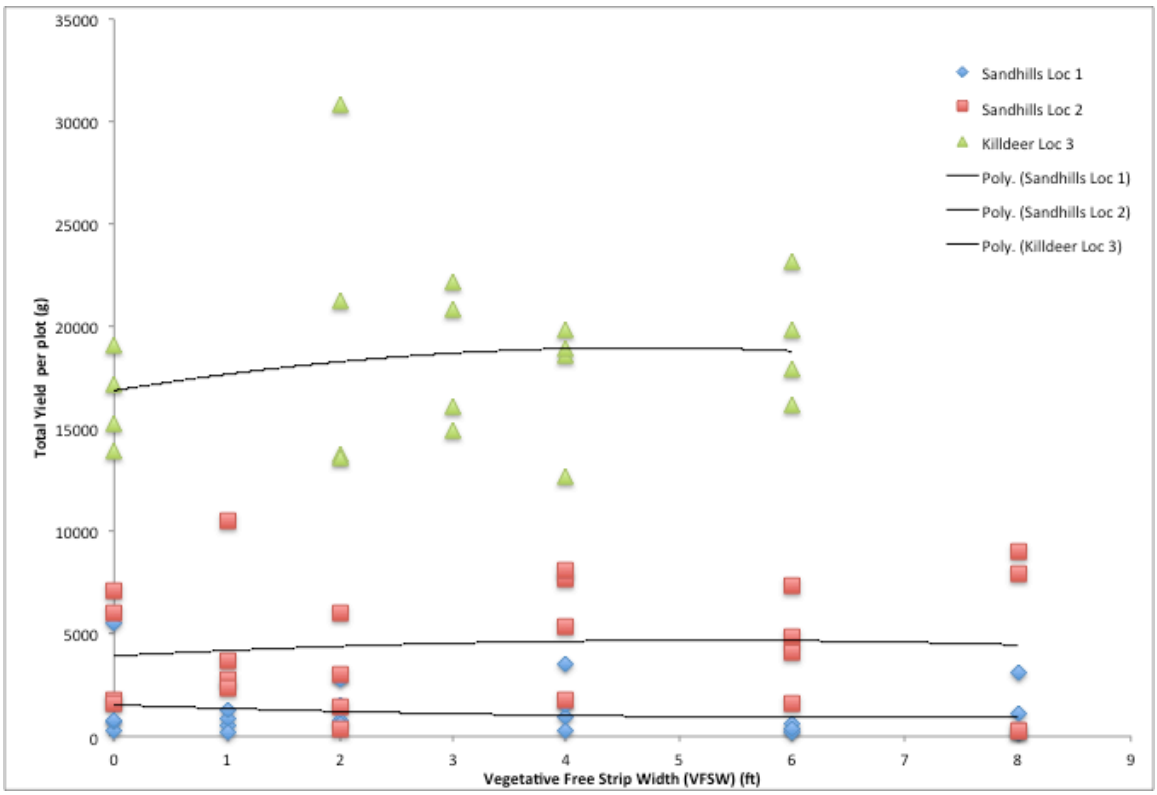

Figure 1. Relationship between vegetation-free strip width and 'Navaho' blackberry yield at Jackson Springs Locations 1 and 2 and King's Mountain NC in 2013. Points represent observed mean data. The line represents predicted values.

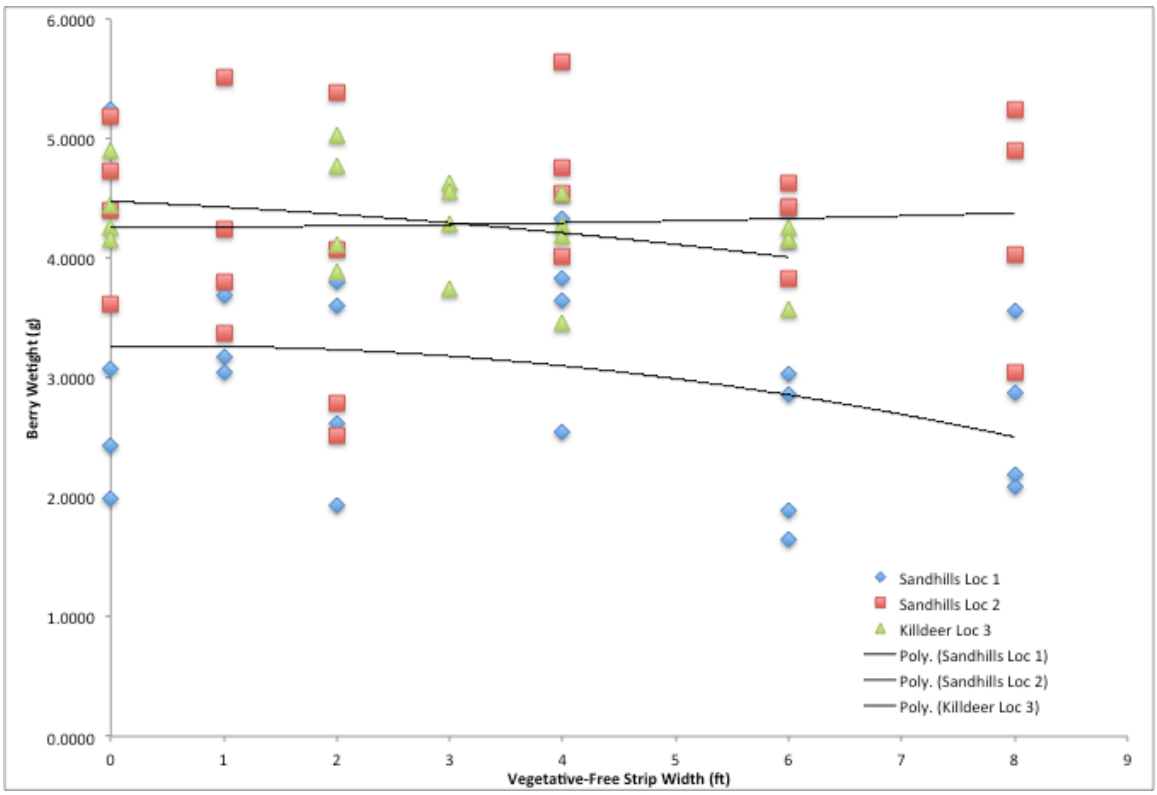

Figure 2. Relationship between blackberry fruit weight and VFSW at Jackson Springs NC and King's Mountain NC in 2013. Points represent observed mean data. The line represents predicted values.