Effect of Mulches on the Establishment of Organically Grown Blueberries in Georgia

G. Krewer[1], M. Tertuliano[2], P. Andersen [3], O. Liburd [4], G. Fonsah [5], H. Serri [6] and B. Mullinix[7]

[1] Dept.of Hort., Univ. of GA, POB 748, Tifton, GA 31793, USA
[2,3] Dept. of Hort., Univ. of FL, NFREC-Quincy, 155 Research Rd., Quincy, FL 32351, USA
[4] Dept. of Nematology and Ento., Univ. of Fla. Gainesville, FL 32611, USA
[5] Dept. of Agricultural and Applied Economics, Univ. of GA, Box 1209, Tifton, GA 31793, USA
[6] Univ. of Concepcion, Campus Chillan, POB 537, Chillan, Chile
[7] Texas A and M Univ.-Lubbock, 1102 EFM 1294, Lubbock, TX 79403, USA

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Abstract

A six year study was conducted to determine the effect of various mulches on the performance of organically grown 'Brightwell' rabbiteye blueberry (*Vaccinium ashei* Reade; syn. *V. virgatum* Ait.). Treatments were an unmulched control, plastic woven ground cover with 3 L (10 cm) of pine bark to seal the planting hole cut in the cover, pine straw (20 cm) and milled pine bark (10 cm). It was necessary to reapply pine straw in years three and six and reapply pine bark in year five. Plants were fertilized with various organic approved fertilizers as needed. Weeds were suppressed by use of various organic "burn down" compounds and hand pulling / hoeing. Only limited weed control was required with the mulch treatments in the first two years. Over time, the amount of hand weed control increased, especially as the ground cover treatment deteriorated and Bermuda grass appeared in the plots. Flea beetles required treatment in several years and gibberellic acid was used in 2007 following a freeze. Pine straw and pine bark treatments produced the largest plants and the highest yields, followed by ground cover and the unmulched control. With the pine straw and pine bark treatments, growth and yields were good and extrapolated yield ca. 7,500 kg / ha in years five and six.

INTRODUCTION

Organic blueberry production has excellent potential in Georgia. The bulk of the crop ripens before the northern organic blueberry production matures and organic prices are often 50% higher than conventional production. However, weed control is the major problem in organic blueberry production in Georgia. How were blueberries grown in Georgia in the pre-chemical age? Typically they were cultivated with a finishing harrow, often in two directions and hand hoed around the plants. This limited production to well-drained sites. Mulches of pine straw and saw dust were also employed. The commercial industry, as it is known today, began to develop in the mid-1970's. A combination of herbicides and rotary cultivating during the winter was typically used to control annual and perennial weeds. Increased use of drip irrigation reduced the use of rotary cultivators in favor of herbicides.

Increased interest in organic production by Georgia farmers started at the turn of the new century with the advent of the Nation Organic Standards (NOP), development of organic sections in grocery stores, and educational efforts of the land grant colleges, Georgia Organics, Inc. and Georgia Fruit and Vegetable Growers Association (www.smallfruits.org, www.goga, www.gfvga). In 2002 we initiated an organic blueberry production program to assist farmers in the development of an organic blueberry industry. Our objectives were to provide farmers with excellent information on the most cost effect methods of organic blueberry culture. We have been addressing problems in fertilization,

weed, insect, and disease control with varying degrees of success. Five experiments have been conducted, or are underway. Many interesting discoveries have been made in the course of these studies.

An initial study was conducted on mature bushes at the Taylor Organic Farm in Alma, Ga. Pine bark and wheat straw provided significant weed control, but wheat straw improved growth and berry size in the year of application (Krewer, 2002). However, wheat straw decomposed rapidly and was expensive (about $US 4000 per ha if purchased in small bales). Pine bark appeared to be a good mulching choice for established bushes due to its relatively long life. Pine bark applied in 2002 was still providing significant weed control in 2006. Pine bark cost was about $US 2000 per ha.

However, the greatest need for weed control research is on young bushes. Weeds can overgrow new plantings of blueberries in three weeks under Georgia conditions, and the season of active weed control in southern Georgia blueberry fields extends from March until October. Establishing new plantings of organic blueberries on a large scale can be difficult. Programs are needed to provide ecologically sound and economical methods of organic blueberry establishment using locally available or low cost materials (Krewer and Walker, 2006).

Mulches have been used successfully in conventional blueberry systems to reduce weed growth, lower soil temperature in summer, help maintain uniform soil moisture, increase growth rate and increase yield (Clark and Moore, 1991; Darrow, 1957; Moore and Pavlis, 1979). However, little data is available from organic blueberry production systems problems where problems with weed control and nitrogen availability can be much more severe. Sciarappa et al. (2008) reported in a two year study that 4-8 cm of organic mulch produced about 95% weed control and a combination of black landscape fabric with organic mulch on top resulted in almost complete weed control. Blueberry growth data was not presented in this study.

In the last seven years four experiments have been conducted with this philosophy in mind: 1) In 2002, an organic planting was established to determine which mulches provided the best weed control, growth and yield under Georgia conditions. The results are reported in this manuscript. 2) In 2003, a plastic mulch layer was modified to apply white-on-black plastic over the top of recently planted blueberries, which provides nearly 100% weed control in the immediate row area. A weed sweeper was also invented to sweep weeds off the plastic and into the throat of the aisle mower (Krewer, 2003). 3) In 2004, an experiment was started to compare conventional production with organic production using white-on-black plastic or pine bark mulch (Krewer et al., 2005). 4) In 2007, an experiment was initiated to evaluate additional mulches available in the blueberry belt of Georgia including peanut shells and landscape fabric. A special rotary cultivar to control weeds on the sides of the raised bed is also being tested.

MATERIALS AND METHODS

In July of 2002, an organic establishment study was begun using rabbiteye blueberries. The rabbiteye blueberry is much better adapted to organic production than the southern highbush. It has modest fertility requirements and is much more tolerant to diseases and weed pressure than southern highbush blueberries. Treatments were an: 1) unmulched control, 2) ground cover (Geotextiles, Enigma, Ga.) with 4 L (10 cm) of milled pine bark to seal the planting hole cut in the fabric, 3) pine straw (20 cm when fresh) and 4) milled pine bark (10 cm). The width of the mulch was 1 to 1.2 m. Experimental design was a randomized complete block with four replications of five 'Brightwell' plants per replication for a total of 20 plants per treatment. Plants were set 1.2 m apart.

Fertilization was provided by two or three applications of organic fertilizer each year including organic cotton seed meal, blood meal, pasteurized chicken litter (4-3-3) (Perdue Co., Seaford, Delaware) and Nature Safe (8-5-5) (Griffin Industries, Cold Spring, Kentucky). Approved formulations of copper and magnesium were applied once. The amount of fertilizer was increased as the plants enlarged over the years, but all plants

were treated the same at each fertilizer application.

Weed control was initially provided by rototilling the edge of the bed and hand hoeing. In years two, three and four, weed pressure in the mulch treatments was light. A series of organic post emergent herbicides derived from acetic or citric acid and essential oils were on the market during these years, and these materials were used in combination with hand hoeing. Over time, most of these organic post emergent herbicides disappeared from the market. There was also a shift in weed population toward greater Bermuda grass (*Cynodon dactylon* (L.) Pers.) pressure. Increased hand hoeing was necessary. Weed control was applied an average of five times per year to a band about four feet wide. No attempt was made to keep the planting totally weed free, as this seemed impractical due to very high labor cost in the U.S., but rather the field was treated as commercial field with a weed control program.

It was necessary to reapply the pine straw twice in six years and reapply the pine bark once. Coarse (large) pine bark was used for the second application. This is a better choice for weed control as the surface layer stays drier and few weed seeds can germinate. The ground cover was left in place for the duration of the experiment, but after year four it became tattered and weed growth increased in this treatment. Organic regulation calls for removal of plastic mulch before it rots, but this is a judgment decision, so we decided to continue with this treatment for the course of the experiment.

Young rabbiteye blueberries only require limited pruning, so most of the pruning was to remove crowded or broken limbs and unwanted twiggy growth in the center of the bush. The bushes were also prepared for mechanical harvest by removal of canes growing outside the center cane cluster and removal of low hanging limbs.

RESULTS AND DISCUSSION

In Sept. 2003, just prior to hand hoeing, the best weed control was provided by the pine straw mulch (15% weed cover), followed by pine bark (38%), ground cover (40%) and control (70%). In 2003, compared to the control, pine straw mulch, landscape fabric, and pine bark mulch significantly increased plant width in row, width across row and growth index (Fig.1). In September, pine straw-treated plants had excellent leaf color and growth. Landscape fabric treated plants had the second best appearance, followed by the pine bark and unmulched control. Leaf nitrogen levels in September were 1.4% with the pine straw and landscape fabric treatments, 1.1% for the control and 1.0% for the pine bark. Other elements were within the sufficiency range for rabbiteye blueberries, except Cu, which was slightly low on the pine bark and pine straw treatments. The growth of the pine straw-treated plants was very acceptable, even compared to conventional non-organic production. It is theorized that pine bark tied up more of the applied nitrogen than pine straw, resulting in better appearing plants with pine straw.

In 2004, the plants made excellent growth and produced a commercially harvestable crop of fruit with good fruit size (Fig. 2). Pine straw mulch, ground cover, and pine bark significantly increased yields compared to the control. The pine straw treatment produced 0.97 kg per plant 24 months after planting. Weed coverage at the end of the season (after regrowth of weeds following treatment) was significantly less in the mulching treatments (60-75% weed cover) than the control (98%). The primary weed problem was large crabgrass (*Digitaria sanguinalis* (L.) Scopoli) appearing late in the season. The organic approved postemergent herbicides provided only temporary control of crab grass, but by 2004, plants set in 2002 were more competitive with weeds.

In 2005, good growth and fruiting occurred in the best treatments. Pine bark mulch and pine straw mulch had significantly greater width in row, width across row, height and growth index than the control and landscape fabric (Fig.1). Weed coverage in August was significantly lower in the control (recently hand hoed), pine bark mulch and pine straw mulch (5-7.5% weed cover) than the ground cover (60%). Hand hoeing was considered a necessity on the control plots in 2005. Weeds were hand pulled in the ground cover, but quickly regrew. Time required to remove weeds was greatest with the control and least with the pine straw mulch. Nature Safe 8-5-5 organic fertilizer was used starting in 2005

and produced good leaf color and growth. Mulching systems influenced leaf nutrient levels. Compared to the unmulched control, pine straw mulch treatment had significantly higher nitrogen (1.4 vs. 1.2%) and manganese (34 vs. 25 ppm) and lower boron (31 vs. 46 ppm) levels in the leaves in August. Compared to the unmulched control, pine bark mulch treatment had significantly higher manganese (38 vs. 25 ppm) and lower sulfur (17 vs. 20 ppm). Yield was significantly greater in the pine straw and pine bark than the control and ground cover (Fig. 2). A yield of 1.38 kg per plant occurred for these treatments. In 2006, 48 months after planting, good growth and fruiting occurred on the best treatments. Pine bark mulch and pine straw mulch had significantly greater growth index and higher yields than the control and ground cover (Figs. 1 and 2). Over four kilograms per plant of mechanically harvested fruit were produced on the best treatments.

In 2007, 60 months after planting, a freeze occurred in April that devastated the blueberry crop at UGA Alapaha Station. Fortunately, this experiment was planted about 30 meters from a forest of 76 year old pine trees. The planting was also treated with gibberellic acid (organic approved) following the freeze to assist with fruit set. As a result, a fairly good crop of fruit was produced. Mean growth index was greatest for the pine bark mulch, followed by pine straw, landscape fabric and the control (Fig. 1). Yields at or above four kilograms per plant occurred with the pine bark and pine straw (Fig. 2). Mean berry was significant greater with pine bark (1.7 g), pine straw (1.6 g), ground cover (1.6 g) than the control (1.4 g).

CONCLUSION

Establishing organic rabbiteye blueberries using pine bark or pine straw mulch with the use of organic postemergent herbicides, limited hand weeding, and organic fertilizers were successful. Good growth and yields where obtained with these treatments. Pine straw provided excellent weed control, is acidic and beneficial to the soil and is an abundant natural resource in Georgia. It does not appear to tie up nitrogen like fresh pine bark. However, it is time consuming to gather or expensive to purchase. Its commercial use may be limited to growers with access to “free” pine straw or in limited applications around young plants. It is also useful in closing holes were plastic mulch in used or damaged. Total yield with pine straw was 10.2 kg per plant. Pine bark produced the highest total yield, 10.56 kg per plant. Pine bark can be applied mechanically, is relatively long lasting and provides an additional rooting zone for blueberry plants. The primary problem with pine bark is that nitrogen may be tied up when the bark is fresh.

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Figures

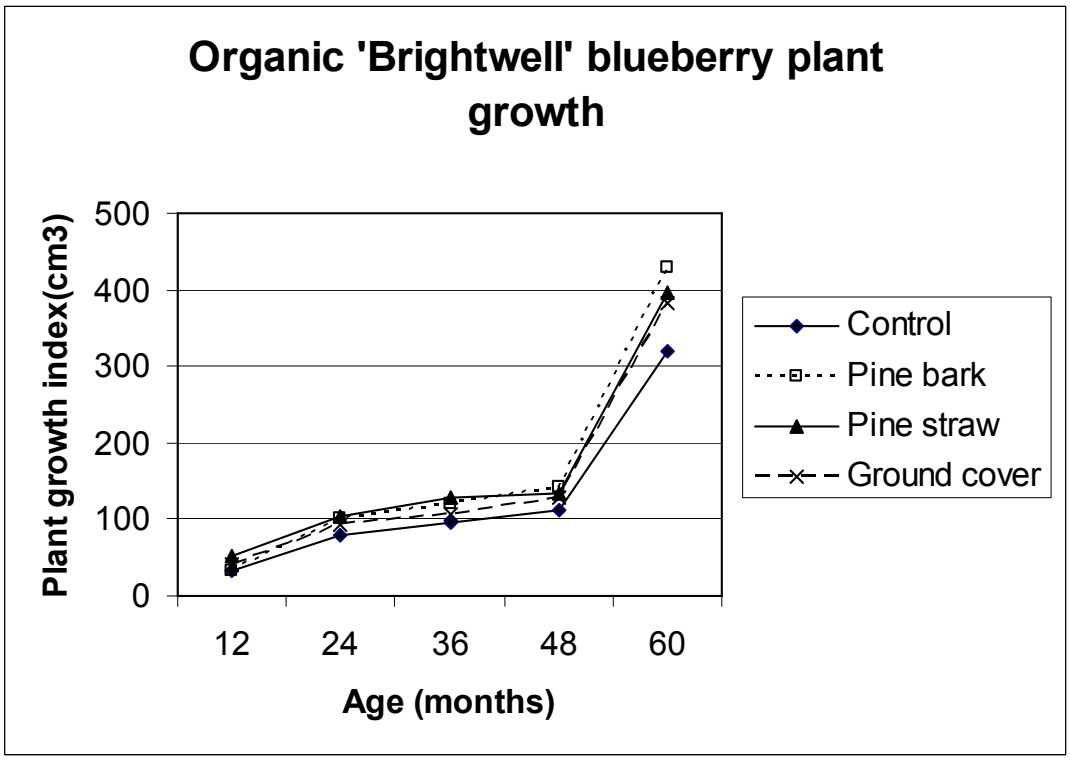

Fig. 1. Effect of mulches on the growth of organically grown 'Brightwell' rabbiteye blueberry.

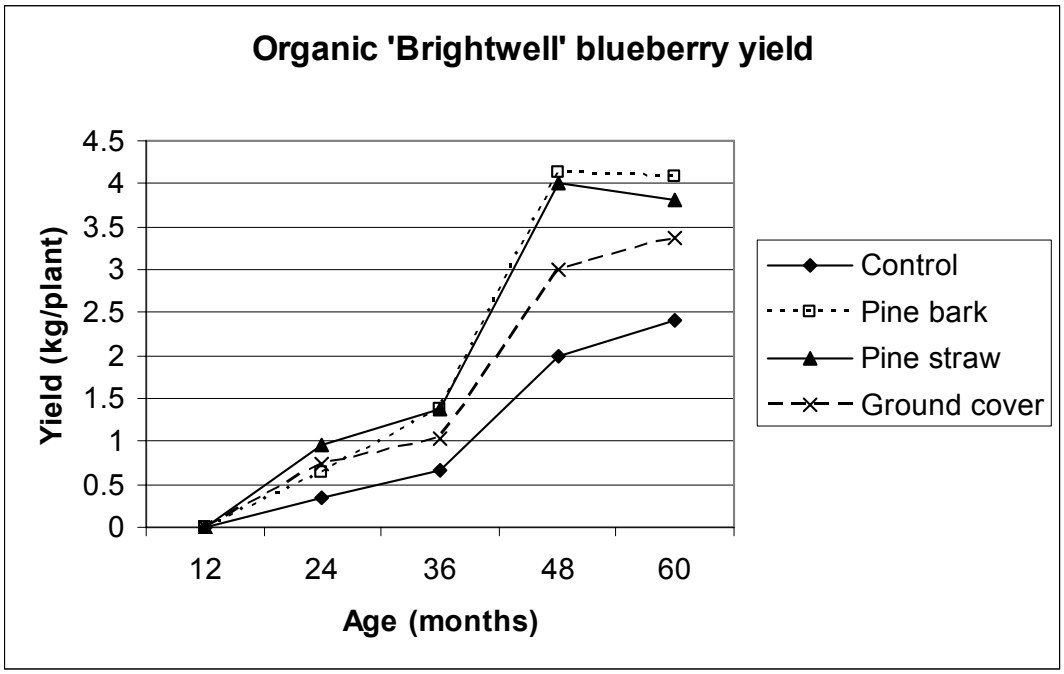

Fig. 2. Effect of mulches on the yield of organically grown 'Brightwell' rabbiteye blueberries