

Title: Establishment and growth of blueberry (*Vaccinium spp.*) affected by pine bark and irrigation

Progress Report

Grant Code: 2014-18

Research Proposal

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Objective: 1) To identify the effect of varying levels of pine bark mulch and irrigation method on growth

Justification: Blueberry production in the Southeastern United States has been increasing. In Georgia alone, blueberry acreage over the last ten years (2003-2013) has increased by an average of 17% per year. The return to the Georgia grower over this time period has increased by 27% fresh and 13% processed. However, this is a bell shaped curve for this 10 year period where the highest returns were in 2007 at \$3.10/lb. and \$1.42/lb. fresh and processed, respectively. In 2014, Georgia produced 56M lb fresh market and 40M lb processed southern highbush fruit. These production values placed Georgia at #1 for fresh market highbush blueberry production in the U.S.

With increasing competition from Mexico, California, and within the Southeastern U.S., blueberry growers will need to identify tools that will minimize establishment costs, provide production precocity, and promote plant health. Presently, growers are using pine bark culture to produce blueberry. Pine bark is an excellent source for maintaining the appropriate soil pH for blueberry production, mulch for weed management, soil organic matter, and soil moisture retention. Along with pine bark, most blueberry plantings are irrigated, usually with low volume drip tape.

The objective of blueberry production is to enter the market at the highest possible monetary return to the farm by utilizing good cultural practices, early maturing, and precocious cultivars with good fruit quality. Blueberry breeding programs in the Southeastern U.S. have recently released varieties that are purported to have characteristics that are suitable for production.

However, questions concerning the best management practice for establishment to realize the cultivar's potential are left unanswered.

This proposal involved an investigation of pine bark amount, irrigation type, and blueberry cultivar response on establishment and growth.

Methods:

In January 2014, land was prepared for bedding. However, spring rains made the ground too wet to cultivate and bedding did not occur until June 2014. In March 2014, 1 gallon potted plants were donated to the blueberry program from Cornelius Farms, LLC., Manor, GA, Alex Cornelius proprietor and Alma Nursery, Alma, GA, Lane Wade proprietor. The varieties selected for this study were the southern highbush releases 'Camellia' and 'Suziblue' and rabbiteye releases 'Titan' and 'Vernon'. All the plant material was stored on a container production area with automated irrigation until planting. Flowers were removed during bloom and all plants received ~ 5 g of 46-0-0 in the pot after bloom. In March, a sample was sent to the UGA Nematode Lab for assay.

During the first week of July 2014, the beds had ~ 10 tons/A or 3in depth of pine bark incorporated into the soil. In addition, irrigation lines were set into place and plumbed. For each cultivar, a row of single line drip tape (0.25 gph at 12" spacing), double line of drip tape (each line 0.25 gph at 12" spacing), or a single drip line with micro emitters (blue Maxijet® 10.5 gph with a 280° fan angle) set at every other plant or 10 ft spacing were positioned and tested before planting.

All the selected cultivars were planted at a 5ft in row spacing with 12 ft between the rows. All plants received ~ 28 g of 46-0-0 after planting. The fertilizer was placed evenly in a 24 in circle around the plant. The plants were also pruned to a 50:50 ratio roots to shoots. Pine bark was next placed on the beds. Under each irrigation treatment, 10 plants were mulched at 9 in, 3 in, or no mulch applied. In addition, 10 plants with 3 in mulch had a single drip line hung 18 in above the apex of the bed.

Agricultural practices for irrigation, pest and weed management are carried out by the UGA Blueberry Research Farm crew managed by Shane Tawzer. Presently, the Campbell Scientific environmental monitoring station is being constructed; the soil moisture and temperature sensors were not received until 10/2014. Growth was measured on 11/14/2014 as new shoot length measurements post pruning and reported as cm to minimize confusion in the text between pine bark depths and shoot length.

Results:

The late planting date caused significant difficulties for establishment. From observations of the new planting of blueberry, there appears to be a shock that the plants expressed through leaf

drop, stem dieback, and slow growth. After pruning, the plants had significant leaf drop and minimal growth. Irrigation was conducted at a minimum of every two days, dependent upon rain. Drip tape proves to be very susceptible to damage, there were 11 breaks within the first three weeks. The micro sprinklers are very susceptible to the wind blowing the water off target and most irrigation events occurred at night. Each irrigation averaged 8 to 12 hrs depending on weather forecasts for temperature, wind, and rain. The test for nematodes was negligible (data not shown).

Only one growth measurement was taken, which was on 11/14/2014. This coincided with a freeze event that began on 11/18/2014 and ended on 11/21/2014 with low temperatures of -3.2, -6.7, -5.9, and -0.9° C, respectively.

‘Suziblue’ Average growth per treatment is shown in Table 1 where single line drip tape with no mulch measured an average of 21.5 cm shoot growth over the 10 plants. The treatment with greatest amount of growth was in the double drip tape with 3 in of pine bark mulch, plants grew a total of 580.1 cm of shoot length over 31 shoots. Interestingly, the treatment with the micro-emitter without any mulch grew a total of 542.3 cm over 36 shoots with an average growth of 15.1 cm. *‘Suziblue’* appears to establish well in all treatments and is tolerant to the no mulch treatment and excels under micro-emitter type irrigation.

‘Camellia’ Growth per treatment is shown in Table 1 where the treatment with micro-emitter irrigation and 9 in of mulch measured 19.9 cm average shoot growth over 30 shoots with 596.9 cm of total growth. Treatments with 3 in of mulch applied displayed a trend of increasing number of shoots and total growth from single to double drip tape to micro-emitters (Table 1). The treatments with no mulch applied were the lowest in total growth regardless of irrigation treatment. *‘Camellia’* responded positively to micro-emitter irrigation though the number of shoots and in total growth for both treatments with mulch. However, the response to no mulch was inhibited with low total growth across the treatments.

‘Vernon’ Growth per treatment is shown in Table 2 where average shoot growth was greatest with single line drip tape and 3 in mulch over 43 shoots with 622.0 cm of total growth. For all pine bark treatments, the double line drip tape had the lowest total growth, suggesting the amount of water provided could be in excess for adequate growth of newly established *‘Vernon’*. Shoot growth was inhibited by the lack of mulch and 9 in of mulch did not positively affect growth when compared to the treatments with 3 in of mulch.

‘Titan’ Growth per treatment is shown in Table 2 where average shoot growth was greatest with double drip tape and 6 in mulch over 22 shoots with 315.3 cm of total growth. The lowest growth was shown in the treatment with no mulch and a single drip tape where the average growth was 8.0 cm over 13 shoots with total growth of 104.6 cm. *‘Titan’s’* growth was affected positively by mulching, whereas, for example, the single drip line in 9 and 3 in mulch has 64 and 57% greater growth, respectively, over the no mulch single drip line treatment.

Raised Irrigation In each cultivar tested, a single line of drip tape over 3 in mulch was hung at an elevation of 18 in above the bed between posts covering 10 plants in order to determine the effect on the drip tape from mammalian predation and the environment. Raised irrigation to date in this trial has had only breaks at the soil line where the line ascends the post. None of the material that is above the bed has been predated or been damaged anthropocentrically or by environmental conditions. Growth under the raise irrigation has not been inhibited and reflects a similar response to growth as the single drip tape with 3 in mulch (Tables 1 & 2).

Table 1 represents the growth measurements of southern highbush (SHB) cultivars Suzibblue and Camellia taken 11/14/2014. Treatment index: S = single line drip tape (0.25 gph/hole @ 12 in spacing); D = double line drip tape (0.25 gph/hole @ 12 in spacing); M = micro-emitter (blue Maxijet[®] 10.5 gph with a 280° fan angle); 9 = 9 inches of pine bark mulch; 3 = 3 inches of pine bark mulch; 0 = no mulch; R = raised irrigation line to 18 in above the bed. Average growth was calculated in SAS 9.3 as Proc GLM (SAS Institute Inc., Cary, NC, U.S.) and a different letter indicates significant difference at $P \leq 0.05$.

Growth Measurements of 'Suzibblue' and 'Camellia' SHB Blueberry: 11/14/2014									
Treatment	n	Suzibblue				Camellia			
		Average Shoot Growth (cm)	Total Length (cm)	Number of Plants with no Growth	Number of New Shoots	Average Shoot Growth (cm)	Total Length (cm)	Number of Plants with no Growth	Number of New Shoots
S9	10	17.2 bc	360.7	3	21	12.8 abc	255.9	5	20
D9	10	13.9 c	402.9	2	29	9.7 bcd	164.1	4	17
M9	10	17.8 abc	391.5	1	22	19.9 a	596.9	2	30
S3	10	17.1 bc	376.6	2	22	14.9 ab	208.3	4	14
D3	10	18.7 abc	580.1	0	31	11.9 bc	251.1	5	21
M3	10	17.2 bc	344.5	2	20	13.5 abc	309.6	3	23
S0	10	21.5 ab	430.5	0	20	6.9 cd	97.2	5	14
D0	10	17.6 abc	368.9	2	21	3.9 d	42.5	8	11
M0	10	15.1 c	542.3	0	36	8.7 bcd	116.5	6	13
S3R	10	23.0 a	528.6	0	23	12.8 abc	204.8	5	16

Table 1 represents the growth measurements of rabbiteye (RE) cultivars Vernon and Titan taken 11/14/2014. Treatment index: S = single line drip tape (0.25 gph/hole @ 12 in spacing); D = double line drip tape (0.25 gph/hole @ 12 in spacing); M = micro-emitter (blue Maxijet® 10.5 gph with a 280° fan angle); 9 = 9 inches of pine bark mulch; 3 = 3 inches of pine bark mulch; 0 = no mulch; R = raised irrigation line to 18 in above the bed. Average growth was calculated in SAS 9.3 as Proc GLM (SAS Institute Inc., Cary, NC, U.S.) and a different letter indicates significant difference at $P \leq 0.05$.

Growth Measurements of 'Vernon' and 'Titan' RE Blueberry: 11/14/2014										
Treatment	n	Vernon				Titan				
		Average Shoot Growth (cm)	Total Length (cm)	Number of Plants with no Growth	Number of New Shoots	Average Shoot Growth (cm)	Total Length (cm)	Number of Plants with no Growth	Number of New Shoots	
S9	10	10.1 abcd	221.9	2	22	11.7 ab	292.4	2	25	
D9	10	7.2 bcde	136.8	6	19	10.6 ab	285.8	1	25	
M9	10	8.7 bcd	287.7	3	33	10.6 ab	201.3	3	19	
S3	10	14.5 a	622.0	0	43	12.7 ab	241.3	2	19	
D3	10	5.7 de	119.1	7	21	14.3 ab	315.3	3	22	
M3	10	11.1 abcd	511.5	0	46	10.3 ab	279.4	0	27	
S0	10	6.2 cde	105.4	6	17	8.0 b	104.6	6	13	
D0	10	2.6 e	31.4	8	12	10.4 ab	207.3	4	20	
M0	10	9.8 abcd	195.9	4	20	8.9 b	222.3	2	25	
S3R	10	12.1 ab	400.7	2	33	16.2 a	274.6	4	17	

Conclusions

This work demonstrates the difficulty of establishing blueberry during the summer months. The leaf drop, tip dieback, and lack of vigor from transplanting material from pots to the field was heightened when combined with the heat and humidity typically encountered in a South Georgia summer. However, there are some cultivar specific responses that make this experiment interesting. 'Suziblue' appears to establish well considering growth response throughout the treatments. Whereas, 'Camellia' displayed very low vigor with as many as 8 plants, in the no mulch double drip tape treatment, having no growth. The rabbiteye treatments reflect a similar trend to growth as the southern highbush treatments. 'Titan' shows greater response to growth throughout the treatments when compared to 'Vernon's' growth response. 'Vernon', too, had as many as 8 plants, in the double drip tape no mulch treatment, without any growth. Generally, across the treatments pine bark mulch was crucial for growth. Micro-emitters benefited all no mulch treatments especially for 'Camellia', 'Vernon', and 'Titan' over the drip tape treatments.

In the spring, mortality, regrowth, and flower counts will be conducted. Due to the experience of this season, the flowers will be removed so that the plant can place photosynthates into shoot and root production.

Impact Statement: The identification of cultivar response to varying amounts of pine bark and irrigation method will allow growers to better manage establishment costs and minimize the length of time to production. ‘Suziblue’s’ positive response to growth in soils incorporated with 10 tons/A pine bark with micro-emitter irrigation represents a cost savings of ~\$400.00 for pine bark, when standard practices call for 20 tons/A at ~\$800.00. However, caution should be exercised in response to the statement because each planting site will have varying soil types, water tables, environmental conditions (wind prone), and or irrigation water quality that can alter response of a plant during establishment.