ESTABLISHMENT OF AN EVERGREEN HIGH DENSITY BLUEBERRY PLANTING IN SOUTHWEST FLORIDA

R. K. REEDER AND R. L. DARNELL  
Horticultural Sciences Dept.  
IFAS, University of Florida  
Gainesville, Florida 32611

T. A. OBREZA  
Southwest Florida Research and Education Center  
IFAS, University of Florida  
P.O. Drawer 5127, Immokalee, Florida 33934

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Abstract. Southwest Florida offers a climate where blueberries may be grown using an evergreen system of production without undue fear of freezes. This system, which involves the application of nitrogen (N) in the fall, would provide a unique early market window for southwest Florida. ‘Sharpblue’, ‘Gulf Coast’, and ‘Wannabe’ southern highbush blueberry cultivars were planted at high density (10,000 plants/hectare) in southwest Florida to determine the feasibility of successful establishment of an evergreen high density blueberry planting system. Additionally, 3 rates of N fertilization and the use of acid peat or municipal solid waste (MSW) compost (composted household garbage with recyclables removed) as soil amendments were evaluated in this study. Soil pH, and the concentrations of soil Ca, Mg, P, as well as K, were increased with incorporation of MSW compost. Peat incorporation decreased the soil Mg and P concentration. At the end of 6 months, plants growing in the compost-amended plots outgrew the plants growing in the peat amended plots. Also at the end of this period, plants receiving 168 kg N/ha were similar in height to plants receiving 252 kg N/ha. This study will continue for 2 years.

Fall-fertilized, containerized blueberries, protected from freezing temperatures, avoid dormancy and produce an off season crop (Reeder and Darnell, unpublished data). Observations of the few commercial blueberry plantings in Florida that use an evergreen system of production indicate that plants will continue to grow vegetatively and reproductively. The flower buds on these plants do not enter dormancy, but instead begin blooming in November and continue through March. Consequently, ripe berries are harvested from January through May (P. M. Lyrene, personal communication). South Florida offers a climate where blueberries may be grown using an evergreen system of production, through fall nitrogen (N) application, without undue fear of freezes. This production system would provide a unique early market window for south Florida when prices are high and competition is low. This evergreen cropping system for blueberry is currently being studied at the Southwest Florida Research and Education Center (SWFREC) in Immokalee, FL. The advantages of planting fruit crops at high densities are well documented (Schneider et al., 1978; Layne et al., 1981; Testolin, 1990; Boswell et al., 1970). Interest in growing Florida blueberries at high density is increasing; however, there is little information on the cultural and management practices required (Austin and Mullinix, 1980; Rosca and Mladin, 1985; Eck and Stretch, 1986). Establishment, survival, and yield of blueberry are enhanced with increasing levels of organic matter (OM) in soils (Griggs and Rollins, 1947; Moore and Pavlis, 1979; Perlmutter and Darrow, 1942; Spiers, 1983). Acid peat is recommended for amelioration of low OM soils that are to be used for blueberry production in Florida (Arnold and Sherman, 1974; Lyrene and Crocker, 1991). The cost of peat is high and while it may be considered a sustainable resource, it can take years for a peat bog to naturally revegetate. The use of other soil amendments has been examined in an effort to reduce the cost of establishment and also to expand the production range of blueberry (Spiers, 1982; Odneal and Kaps, 1990; Dzierz et al., 1986).

Municipal solid waste (MSW) compost may be a cost effective, environmentally sound alternative to peat as a soil amendment for blueberries. This compost is composed of the organic fraction of urban garbage, including food scraps, yard trimmings, and paper that is not recyclable. Land application of MSW compost is an environmentally and economically sound waste management alternative (Kidder, 1993). Incorporation of MSW compost into the soil profile has benefited the production of vegetable (Manios and Kapetanios, 1992; Obreza and Reeder, 1994) and ornamental crops (McConnell et al., 1991; Smith, 1992); however, the feasibility of using MSW compost as a soil amendment for blueberry production has not been examined.

Nitrogen is considered the most limiting nutrient affecting plant growth in most cropping system (Barker and Mills, 1980). Current recommendations for N application in Florida blueberry plantings are based primarily on observations (Arnold and Sherman, 1975, Lyrene and Crocker, 1991), and quantitative data are lacking. There are few reports of N rate effects on blueberries planted at high density (Austin and Mullinix, 1980; Moore et al., 1993), and no reports for a high density evergreen system. The present research addresses the initial establishment (first six months after planting) of an evergreen high density blueberry planting in southwest Florida in relation to N nutrition and soil amendment.

Materials and Methods

A high density blueberry planting (10,000 plants per hectare), using an evergreen production system, was established at the University of Florida, SWFREC, at Immokalee. The soil is an Immokalee fine sand (sandy, siliceous, hyperthermic Arenic Haplaquod). The site was cleared and the brush burned during 1992. Two representative soil samples taken at the site in Aug., 1993 revealed an average soil pH (1:2 soil:water) of 4.8 in the top 0.46 m of soil.

The field was left fallow until Jan., 1994, when the site was disked to undercut the weed growth that had accumulated since the land had been cleared. In Mar., 1994, prior to planting the land, the spoil from an adjacent drainage canal was

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evenly distributed over the site. Two beds (oriented north to south) were formed (13.4 m wide with an elevation of about 0.5 m) from the spoil dug from a swale that subsequently separated the beds. The experimental area (centered along each bed) is 5 m wide and 126 m long on the west bed and 5 m wide and 168 m long on the east bed. A solid set irrigation system using revolving sprinklers, emitting 7.6 liters per minute, spaced 7 m apart, was installed down the center of each experimental area to: 1) apply irrigation, 2) leach fertilizer past a 10 cm layer of mulch, into the root zone of the plants, and 3) protect against frost.

In mid March, a 0.025 m layer of acid peat (Tu-co Peat Inc., Sebring, Fl) was applied to one half (randomly selected) of each replication and incorporated into the soil to a depth of 0.15 m. Eweson compost (Bedminster Bioconversions, Inc., Cherry Hill, NJ), a MSW compost treated with wastewater residuals which prime the composting process, was applied to the other half of each replication and incorporated. Prior to incorporation, the Eweson compost was treated with a wettable sulfur (336 kg sulfur/ha) encapsulated in bentonite clay (9:1 sulfur:bentonite clay) to reduce the pH.

Rooted cuttings (approximately 8 months old) of 'Sharpleaf', 'Wannabe', and 'Gulf Coast' were planted in a 1 m x 1 m spacing in early Apr., 1994. Advanced selections from the University of Florida Blueberry Breeding Program were used as border row plants. After planting, the beds were mulched with pine bark to a depth of 10 cm.

Soil samples were taken in each sub-plot in late March (prior to amendment incorporation) and late April (after planting) to determine soil pH (1:2 soil:water) and Mehlich 1-extractable Ca, Mg, P, and K levels. Methods of soil analysis are described in Hanlon and DeVore, 1989. Additional soil pH measurements were taken every 6 weeks. One week after planting, initial shoot height was recorded. Subsequently, shoot height was measured every 6 weeks. Plant mortality was determined by recording replants.

Three weeks after planting, 84 kg N/ha was broadcast over the entire experiment. Nitrogen fertilization treatments began 3 weeks later when mulch had been applied to the entire planting. The fertilization treatments included a base rate (1x), twice the base rate (2x), and three times the base rate (3x), or 84, 168, and 252 kg N/ha, respectively. Nitrogen (ammonium sulfate) was broadcast (1/13 of total for each treatment) at 3-week intervals. Additionally, the entire experiment received a 1x rate of 0N-4P-8K-2Mg with every other fertilizer application.

The experimental design is a split-split-block replicated seven times. This 2 x 3 factorial consists of the following treatments: 2 soil amendments (peat vs. MSW compost), 3 levels of N (1x, 2x, and 3x, or 84, 168, and 252 kg N/ha respectively), and 3 cultivars of southern highbush blueberry ('Sharpleaf', 'Wannabe', and 'Gulf Coast'). East and west of the 3 cultivar rows are border rows, totaling 5 plant rows. There are seven plants per cultivar in each soil amendment by N rate replication (5 x 7 m area); however, only the five central plants of each cultivar are used as data plants.

Results and Discussion

Overall mean mortality was less than 6%. Plant death was not related to treatment (data not shown). At planting, some of the rooted cuttings were suspected of lacking viable axillary buds. These plants eventually died and were replanted. Later, some of the dead plants were found to have been damaged by beetle grubs which had eaten the main roots back to the stem. Both of these conditions are believed to be the primary reasons for plant death.

Soil analysis revealed a significant (p ≤ 0.05) pH increase for MSW compost-amended plots (Table 1), despite our initial efforts to circumvent this effect. An additional elemental sulfur application (336 kg/ha) was broadcast on top of the mulch of the compost-treated plots in June. However, to date there has been little decrease in pH of the MSW compost amended soil. Soil pH was unaffected by the peat soil amendment.

Incorporation of MSW compost into the soil profile increased the Mehlich-1 extractable Ca almost 10-fold. Additionally, Mg, P, and K concentrations in the soil solution also increased when compared to unamended soil. Conversely, peat addition appears to have diluted the soil concentrations of Ca, Mg, P, and K.

There was an initial suppression of the growth of plants in the compost amended plots, when compared with those of the peat amended plots (Table 2). This effect was transient, however, as the plants growing in the compost-amended soil outgrew the plants growing in the peat-amended soil by the end of 6 months. The transient suppression may be due to N robbing associated with immature compost (Obreza and Reeder, 1994). Although blueberries reportedly show signs of nutritional deficiencies at pH above 5.0 (Hanson, 1986), there have been no visible nutritional deficiencies of plants growing in the compost-amended plots. Much of the root growth in both soil amendments is occurring in the mulch (pH 4.7, determined in August). While this may account for lack of high pH-induced deficiency symptoms in plants growing in the MSW compost amendment, it would not adequately account for differences in growth between treatments. The enhanced growth of plants grown in the MSW compost-treated soil is likely a consequence of the enhanced nutritional status of that soil.

Table 1. Soil pH and nutrient concentration before and after amendment incorporation.

<table>
<thead>
<tr>
<th>Soil Amendment</th>
<th>Soil pH</th>
<th>Ca</th>
<th>Mg</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>mg/kg soil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSW Compost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>4.6b'</td>
<td>39b</td>
<td>8b</td>
<td>8b</td>
<td>4b</td>
</tr>
<tr>
<td>Post</td>
<td>6.2a</td>
<td>344a</td>
<td>35a</td>
<td>34a</td>
<td>18a</td>
</tr>
<tr>
<td>Peat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>4.6b</td>
<td>43b</td>
<td>8b</td>
<td>10b</td>
<td>4b</td>
</tr>
<tr>
<td>Post</td>
<td>4.7b</td>
<td>29b</td>
<td>5c</td>
<td>4c</td>
<td>3b</td>
</tr>
</tbody>
</table>

'Mean separation within columns by Duncan's Multiple Range Test, 5%.

Table 2. Plant height increase of blueberry plants in relation to soil amendment.

<table>
<thead>
<tr>
<th>Soil amendment</th>
<th>Days after planting</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>47</td>
<td>91</td>
</tr>
<tr>
<td>MSW compost</td>
<td>3.3</td>
<td>7.5a'</td>
</tr>
<tr>
<td>Peat</td>
<td>4.5</td>
<td>9.5b</td>
</tr>
</tbody>
</table>

'Plant height increase equals mean plant height minus mean initial plant height for each date specified.

'Mean separation within columns by t-test, 5%.
Height increase of plants receiving a 1x (84 kg/ha) rate of N was less than the 2x and 3x rates 6 months after planting (Table 3). Initially, the plant height increase of 2x N treated plants was similar to the 1x treatment. This trend was reversed 171 days after planting. It appears that a 2x rate of N will produce plants similar in height to plants receiving a 3x rate. It is much too early to make firm conclusions about N rate effects on blueberry planting establishment because the establishment phase lasts until the plants have attained a canopy large enough to support a crop, normally 2 to 3 years.

Explaining the initial height increase response of blueberry to different levels of N fertilization is complicated. Nitrogen robbing in the pine bark mulch is likely occurring with the initial N application(s), regardless of rate. It has been observed in this planting that the plants are breaking vegetative bud and flushing at different frequencies and intervals. Decreasing the time between plant height measurements or developing a different nondestructive method to determine N rate effect on biomass production may yield clearer results.

Preliminary data from this study suggest that during the initial establishment (first 6 months) of a blueberry planting 168 kg N/ha will produce plants similar in height to plants receiving 252 kg N/ha. Additionally, MSW compost appears to be a beneficial soil ameliorant for soils low in OM intended for blueberry production, despite an increase in soil pH associated with the compost amendment. Further investigation into the long term effects of N rate and the use of MSW compost in blueberry planting establishment is currently being undertaken.

**Literature Cited**