be highly resistant. Transgressive segregation for damage resistance was expressed.

The plants from damage susceptible cultivars which germinated and looked normal following the drop test were proportionately much smaller than their checks when compared to those of the resistant lines. This is similar to the observations of Waters and Atkin (12) on the effects of loss of part or all of a cotyledon, except our analyses were based on visually normal plants and we excluded those with loss of primary leaf tissue or growing points. Also, it should be noted that seedlings from the undamaged checks of the resistant lines were more vigorous than from the susceptible cultivars.

When the seed quality of the Idaho and New York, (belt threshed) grown seed were compared (Table 3), the germination of the Idaho grown seed was higher than for New York grown seed, but following dropping (5–6% moisture) there was no significant different in performance. TVC and SH were similar for all 3 sources of seed. This substantiates that the seed quality factors studied are genetic and were not affected appreciably by location of growth of seed.

Selection is effective for white seeded beans with resistance to mechanical damage which will produce uniformly high seedling vigor. This should contribute to the increases in yield from commercially planted narrow row snap beans. Presently in many commercial plantings the variation in seedling size results in some small plants which produce no yield. Superior seed quality should eliminate or reduce this seedling size and vigor variation.

Literature Cited


Cranberry Growth and Production in Relation to Water Table Depth

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Additional index words. Vaccinium macrocarpon, water management

Abstract. The response of 'Early Black' cranberry (Vaccinium macrocarpon Ait.) to different water table depths maintained in new bogs on an Atsion sand in New Jersey was measured over a period of 5 years. A 30–38 cm water table resulted in significantly higher fruit yields in 4 out of 5 years when compared with plantings at a water table of 46–54 cm and in 3 out of 5 years when compared to plantings maintained with a water table at 38–46 cm. Average vine length was greatest in plantings at the 46–54 cm water table depth, and the number of fruiting uprights was greatest in plantings maintained at the 30–38 cm water table depth. Differences in water table depth did not influence fruit rot in plantings that received fungicide treatments, nor was color of fruit influenced by water table.

Water management is a critical phase of cranberry production. The winter flood, early vs. late drawing of the winter flood, refloors for frost and insect control, and the control of water depth for summer irrigation are all aspects of the intricate water management system required for successful cranberry production.

In the first effort to determine the best water table depth to maintain for optimum cranberry growth and production, Beckwith (1) found that the greatest production of 'Howes' cranberries occurred at a water table depth of 23–30 cm. The length of the uprights increased with increasing water table depth and the max no. of uprights per 30 cm² were produced at the 23–30 cm water table. In subsequent studies Beckwith (2) found that a water table of 30–38 cm was best for bogs that

1Received for publication March 16, 1976. Paper of the Journal Series, New Jersey Agricultural Experiment Station, Cook College, Rutgers-The State University of New Brunswick.
were sanded.

Chandler (3) observed that irrigation via supply ditch had little effect on the water level within the bog when the lateral water movement was through peat. When the water table was within 30 cm of the surface there was a close correlation between the water and the ditch water. At this depth under these experimental conditions (an accumulation of 25–30 cm of sand) the lateral movement of water through the sand was apparently rapid.

Hall (5) studied the effect of controlled water table depth on growth of new ‘Beckwith’ and ‘Pilgrim cranberry plants in containers. Initial growth of plants on a high water table (5.5 cm) was the most rapid but overall growth was greatest on a 19.5 cm water table. Roots formed a dense mat near the surface of the soil in the high water table treatment. The least growth occurred at a low water level (34.5 cm). At this level the growth rate did not increase rapidly until after 6 months and root systems of plants at this level were long with few laterals except near the water level. The root systems of plants grown at the medium water table depth were less extensive but deeper than the root systems of plants grown at the high water table. Cultivars did not differ in growth response to the different water table depths.

It has been suggested (4) that the water table in newly established sanded bogs could be safely lowered since the roots would develop to depths at which water was available. The implication is that this deeper rooting might even be beneficial to the cranberry plant in withstanding summer water stress. The construction of new cranberry bogs from virgin land at the New Jersey Blueberry-Cranberry Research Center in Chatsworth represented a unique opportunity to test this hypothesis.

Materials and Methods

Between 1964 and 1966 six 0.2 ha bogs, with individual water control structures, was constructed on virgin acreage in the Walton State Forest. The soil was an Atsion sand averaging 6% organic matter and characterized by a 20 cm dark gray plow layer over a 25 cm light gray A2. An iron-ore hardpan ranging in depth from 100–130 cm maintained a water table at ground level which was controlled by drainage and supply reservoir. Bogs were constructed and allowed to remain fallow for a year. ‘Early Black’ cranberry vines were planted in 1966 at the rate of 5000 kg/ha.

During the first growing season the water table in all bogs was maintained within 30 cm of the surface and supplemental sprinkler irrigation was used to insure uniformity of stand. Throughout the second growing season differential water table depths of 30–38 cm, 38–46 cm and 46–54 cm were gradually developed in each of 2 bogs. A series of observation tiles were sunk down the middle of the bog for water table monitoring. Bogs were maintained at these different water table depths thereafter except for the winter flood and the frost refloows. Plantings received fertilizer and insecticide and fungicide sprays according to recommended commercial schedule. First yields were obtained in 1970.

A representative yield sample from the entire bog was taken by dividing it into 12 equal blocks. Within each block 6 separate 30 cm² areas were harvested and yields were combined. The yield for each bog then represented an average of these 12 composited samples. Yields for 1970–1974 were reported as g/30 cm² (approx. equivalent to barrels/acre).

Berry size, anthocyanin content and % fruit rot were also measured. Vegetative growth measurements included no. of new vines produced, vine length, no. of fruiting and non-fruiting uprights and their average length. All data were subjected to the analysis of variance, and treatment differences were tested by Duncan’s Multiple Range Test.

Results

Yield. In 4 of the 5 years, bogs that were kept at the highest water table depth yielded more fruit than bogs maintained at the lowest water table depth (Table 1). The high water table treatment also yielded more fruit in 3 of the 5 years than did the medium water depth. In 2 of the 5 years the bogs controlled at the medium water table depth outyielded the low water table bogs. Average yield was greatest for the highest water table treatment, intermediate at the medium water table depth, and least for the low water treatment.

Berry size. The deep water table was associated with larger fruit than the higher water table depths during the first 2 years (Table 2). In 2 of the 5 years there was no difference in fruit size between treatments. In 1973 berries from bogs maintained at the low water table depth were significantly smaller than berries from bogs kept at the higher water table depths. Also in 1973, berries from the medium water table treatment were larger than those from the high water treatment. In 1973, a particularly heavy crop year, smaller berries associated with low water table contributed to the depressed yields from this treatment. On the average the smallest berries came from bogs maintained at the highest water level.

Berry quality. Based on 5 years of observation there was no significant effect of varying water table depth on fruit rot (Table 3). In the 3 years that anthocyanin content was measured samples from 3 of the 5 years were near the same level. Berries from Medium water depth were significantly larger and had higher anthocyanin content than berries from the High water depth but there were no differences in anthocyanin content between Low and Medium water depths (Table 4).

Table 1. Effect of water table depth on 'Early Black' cranberry yield.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>30–38</td>
<td>97a</td>
<td>197a</td>
<td>123a</td>
<td>191a</td>
<td>155a</td>
<td>153a</td>
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<tr>
<td>38–46</td>
<td>69b</td>
<td>176b</td>
<td>107a</td>
<td>204a</td>
<td>119b</td>
<td>135a</td>
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<tr>
<td>46–54</td>
<td>67b</td>
<td>143c</td>
<td>112a</td>
<td>170b</td>
<td>124b</td>
<td>123a</td>
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Table 2. Effect of water table depth on fruit size of 'Early Black' cranberry.

<table>
<thead>
<tr>
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</thead>
<tbody>
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<td>30–38</td>
<td>0.925a</td>
<td>1.020a</td>
<td>0.909a</td>
<td>1.019a</td>
<td>1.139a</td>
<td>1.002a</td>
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<td>38–46</td>
<td>0.923a</td>
<td>1.039a</td>
<td>0.930a</td>
<td>1.035b</td>
<td>1.147a</td>
<td>1.014a</td>
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<td>46–54</td>
<td>0.967b</td>
<td>1.079b</td>
<td>0.902a</td>
<td>0.991b</td>
<td>1.139a</td>
<td>1.016a</td>
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</table>

Table 3. Effect of water table depth on fruit rot in 'Early Black' cranberry.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>30–38</td>
<td>6.3a</td>
<td>7.5a</td>
<td>6.2a</td>
<td>3.9a</td>
<td>5.1a</td>
<td>5.8a</td>
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<tr>
<td>38–46</td>
<td>6.5a</td>
<td>5.0a</td>
<td>4.8a</td>
<td>2.5a</td>
<td>6.0a</td>
<td>5.0a</td>
</tr>
<tr>
<td>46–54</td>
<td>6.1a</td>
<td>7.1a</td>
<td>5.9a</td>
<td>3.3a</td>
<td>7.8a</td>
<td>6.0a</td>
</tr>
</tbody>
</table>

Table 4. Effect of water table depth on anthocyanin content of 'Early Black' cranberry.

<table>
<thead>
<tr>
<th>Water table (cm)</th>
<th>1972</th>
<th>1973</th>
<th>1974</th>
<th>Avg</th>
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</thead>
<tbody>
<tr>
<td>30–38</td>
<td>173a</td>
<td>319a</td>
<td>408a</td>
<td>300a</td>
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<td>38–46</td>
<td>160a</td>
<td>317a</td>
<td>430a</td>
<td>302a</td>
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<td>46–54</td>
<td>169a</td>
<td>310a</td>
<td>404a</td>
<td>294a</td>
</tr>
</tbody>
</table>

Table 5. Effect of water table depth on growth of 'Early Black' cranberry.

<table>
<thead>
<tr>
<th>Water table (cm)</th>
<th>Runner growth (cm)</th>
<th>No. runners</th>
<th>Avg runner growth (cm)</th>
<th>No. non-fruited uprights</th>
<th>Avg length non-fruited uprights (cm)</th>
<th>No. fruiting uprights</th>
<th>Avg length fruiting uprights (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30–38</td>
<td>944a^2</td>
<td>39a</td>
<td>22.3a</td>
<td>129a</td>
<td>6.49a</td>
<td>160a</td>
<td>7.34a</td>
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<tr>
<td>38–46</td>
<td>952a</td>
<td>35a</td>
<td>25.3ab</td>
<td>115a</td>
<td>6.38a</td>
<td>150a</td>
<td>7.24a</td>
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<tr>
<td>46–54</td>
<td>983a</td>
<td>33a</td>
<td>30.9b</td>
<td>145a</td>
<td>6.88a</td>
<td>155a</td>
<td>7.26a</td>
</tr>
<tr>
<td>30–38</td>
<td>1116a</td>
<td>47a</td>
<td>23.6b</td>
<td>177a</td>
<td>6.65a</td>
<td>107a</td>
<td>6.67a</td>
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<tr>
<td>38–46</td>
<td>854a</td>
<td>37a</td>
<td>20.9a</td>
<td>184a</td>
<td>6.56a</td>
<td>103a</td>
<td>6.77a</td>
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<tr>
<td>46–54</td>
<td>1097a</td>
<td>44a</td>
<td>24.7b</td>
<td>196a</td>
<td>6.22a</td>
<td>98a</td>
<td>6.91a</td>
</tr>
</tbody>
</table>

*Mean separation in columns by Duncan's multiple range test, 5% level.

measured it was apparent that water table depth had no effect on red color development in the fruit (Table 4).

**Growth.** In the 2 years of growth measurement no differences in the no. of runners or the total amount of runner growth was found between water level treatments (Table 5). The average length of the individual runners, however, was greatest at the deep water table treatment. No differences between treatments were found in the no. of fruiting or non-fruiting uprights or in their average length. The trend toward increased no. of fruiting uprights with increased height in the water table observed in 1973 and 1974 would suggest that more uprights may in part be responsible for the higher yields associated with high water table depth.

**Conclusions**

Platings of 'Early Black' cranberry can be developed adequately on Atsion sands at water table depths maintained as low as 54 cm, however, fruit production on these sands is greatly improved by a water table maintained at 30–38 cm. This greater productivity may be related to a greater no. of uprights bearing fruit and during a heavy crop year is also related to larger fruit size. Water table depth does not influence the incidence of fruit rot when fungicides are used nor does it affect the color of the fruit.

**Literature Cited**


**Prevention of Winter Sunscald Injury in Michigan Orchards**

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Additional index words. winter injury, sour cherry, Prunus cerasus, sweet cherry, Prunus avium

**Abstract.** Seven types of protective or sun reflecting materials were tested on the trunks of sour cherry (Prunus cerasus L. cv. Montmorency) and sweet cherry (Prunus avium L. cv. Hedelfingen and Napoleon): (Comfort Coat), aluminum foil wraps, 24 gauge aluminum pipe, urethane foam wraps, white latex paint, fiberglass insulation, fiberglass insulation with a plastic covering and heating cables overlain with fiberglass insulation. While all were efficacious to some degree good quality outdoor white latex paint applied to the S and SW sides of tree trunks was shown to be most practical preventing winter sunscald injury. From noon to 3 PM on bright, sunny winter days, white latex paint treated tree trunks maintained an 8—16.7°C (15—30°F) cooler temperature on the S side than unpainted check trees.

1 Received for publication October 4, 1975.

2 Associate Professor, Department of Horticulture, Michigan State University, East Lansing and District Horticultural Agent, Traverse City.

3 Professor. Approved for publication as Journal Article Number 7326, Michigan Agricultural Experiment Station. The authors acknowledge Mr. Leslie Jamieson, Old Mission Peninsula, Traverse City, Michigan, for furnishing the site for this research; and Consumers Power Company of Michigan for providing the electrical energy.