Screening Melons for Adaptability in North Carolina

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INTRODUCTION

Cantaloupe or muskmelon (Cucumis melo var. cantaloupensis, Cucurbitaceae) production is an important industry for North Carolina. In 2000, North Carolina produced 729 ha (1,800 acres) of cantaloupes valued at $20 million. Besides cantaloupe, there is a tremendous diversity of melons in the Cucumis melo species, each having unique flavors, texture, and appearance. Because of low profit margins in agronomic crops such as corn, soybean, and small grains; and because of nearly a 50% reduction in the tobacco quota over the past four years, North Carolina growers are in desperate need to find other crop options that are profitable. Growers are seeking to diversify the crops they grow to maintain viable farm operations. It is critical to the economic prosperity of eastern North Carolina.

There are several groups of melons other than cantaloupes that are not traditionally grown or are unique to production in the southeastern United States. Honeydew (Cucumis melo var. inodorus) is the second most grown melon in the United States; however, nearly all significant commercial production is located in the southwestern United States where more favorable conditions of a dry, warm climate exist (Rubatsky and Yamaguchi 1997). With increased breeding efforts on honeydew, there may be some cultivars that are more adapted to the humid, hot, southeastern United States growing conditions, especially earlier maturing cultivars (Elmstrom and Maynard 1992).

Another melon type grown for export to Europe is green-fleshed cantaloupes. These melons were developed by breeders in Israel (Simon et al. 1993a). One of the first cultivars developed was named ‘Ha Ogen’ (Goldman 2002) followed later by an improved cultivar ‘Galia’. These melons are sometimes referred to as Galia types of melons in the United States. Besides having green flesh, a Galia type of melon differs from an orange flesh cantaloupe by having the rind turn from dark green to golden yellow when ready for harvest. The fruit are harvested from the vine prior to slip. Additionally, the green flesh of a Galia melon is much softer than the firm flesh of a honeydew and is typically softer than an orange flesh cantaloupe. Galia melons typically are very fragrant but with limited shelf life.

Juan Canary melons are another type of melon that is primarily grown in hot, dry climates. Juan Canary melons are sold in the United States as a specialty item. The fruit are attractive with a smooth rind becoming golden yellow as the fruit ripen. Fruit are harvested prior to slip stage and can be difficult to determine when ready for harvest. The interior flesh is firm, and is usually light green or white sometimes with a hint of orange near the cavity of the fruit, depending on the advanced line or cultivar. Some seed companies have renewed their efforts to improve this melon with regards to adaptability in more humid growing conditions and disease resistance. Several new cultivars are available. However, one of the drawbacks with this melon type, as well as several other types that are mentioned in this paper, is the lack of familiarity with the product by the consumer.

Like Galia melons, Japanese melons have green flesh. However, Japanese melons have a much firmer flesh than Galia melon types and have more pronounced netting when they near harvest. These melons are often grown in greenhouses in Japan and command a very high price with some fruit costing over $50 each. Japanese melons are often given as gifts. These melons are harvested prior to slip.

Other melon types include the Piel de Sapo (Christmas), charentais, oriental crisp-flesh, crenshaw, and ananas melons. The Christmas melon is a favorite in Latin America but not well known to the American

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consumer. The charentais is popular throughout Europe and sold in place of the cantaloupe which is the
primary melon purchased in the United States. The Asian population is especially fond of the oriental crisp-
 malaysia melon, while crenshaw and ananas melons typically have limited shelf life and usually best fill niches in
local markets such as roadside stands.

Each of these melon types have unique textures, flavors; and vary in their sweetness and shelf life. De-
termination of the optimum time to harvest can also be challenging among or within melon types. The pri-
mary goal of our melon screening program is to assess advanced lines of the different melon types and determine
their adaptability to North Carolina growing conditions. The other objective, which is equally important, is to
take promising cultivars of various melon types and test market them for buyer and consumer acceptance. It is
important that markets are developed in concert with production as this information is being developed. The
last major objective of the screening program is grower participation in the marketing development with the
ultimate goal of having a melon that can be successfully grown and marketed by North Carolina farmers for
profit.

METHODOLOGY

Melons that provide alternatives to the traditional cantaloupe have been evaluated periodically in North
Carolina beginning in the early 1990s. Since the formation of the Specialty Crops program in 1997, the evalu-
ation of specialty melons has been an important component of that program (Schultheis et al. 1997, 1998,

Prior to the production season, seeds for a variety of specialty melon types are obtained by contacting
international and national seed company representatives, and plant breeders. The seeds are donated in all
cases. Specialty melons are considered in this program as any melons other than the traditional orange flesh
(western or eastern types) cantaloupes. The primary types of melons include ananas, charentais, Juan Canary,
Japanese, honeydew, oriental crisp-flesh, and Piel de Sapo. Each year, seeds are planted into a soilless mix in
transplant trays in late March. Transplants are ready for field planting in approximately four to six weeks in
late April or early May when the danger of frost has past.

For the initial planting year, each melon entry is planted in a 10 to 12 m strip (15 to 20 plants) on black
plastic mulch. Plants are spaced 0.6 m apart in row and 1.5 m apart between rows. Fertilization and irrigation
is with drip tape throughout the growing season. In 1997 and 1998, the initial years of evaluation, the melons
were evaluated for yield, fruit size, and sugar content. In subsequent years (1999–2001) melons were evalu-
ated for yield potential, average fruit weight, time to harvest, fruit shape and size, sugar content, flavor, flesh
texture, optimum time to harvest, and shelf life. Based on these characteristics, melon cultivars which show
potential for commercial production, are included in the screening trial the second year. Melons that are highly
 perishable are typically excluded from the trials the following season; however, several cultigens exhibiting
unique characteristics the first year are included in a second evaluation.

In the subsequent year of testing, new entries are obtained and included with those repeat cultivars as
described above. Some of the most promising cultivars are grown in greater quantity to provide samples for
test marketing at farm markets, or independent grocery stores. In some cases, several boxes may be included
as part of a trailer load with grower cooperators. The melons are all grown on the research station to minimize
the risk to the grower.

If a melon is particularly well received based on market sampling the second year, a few growers volun-
teer to produce small crop areas (0.2 to 0.4 ha) of the melons the third year in order to provide some volume
for test marketing. Additional small areas may be grown to follow the growth and development of the melon
more closely, and provide additional supply of product over an extended time period for market analysis and
development.

Based on consumer acceptance derived from the market testing of the melon, increased grower partici-
pation and crop area occurs the fourth year. Support is provided through the entire evaluation process and as
the new melon is marketed through research, extension programming, and marketing by North Carolina State
University, The North Carolina Cooperative Extension Service, and the North Carolina Department of Agri-
culture and Consumer Services, respectively.
Vegetables

Funding for this program has been given by the College of Life & Agricultural Sciences, North Carolina State University; the North Carolina Cooperative Extension Service; a special legislative bill supporting business growth and development in eastern North Carolina (Global Transpark), and the Golden Leaf Foundation which utilizes funds obtained through the tobacco settlement.

RESULTS

Ananas, Charentais, and Crenshaw Melons

Several of the melon types that have been examined to date in the melon screening program lack the key characteristics necessary for successful production and shipping from North Carolina. For example, all of the ananas melons that we have evaluated thus far ripen very quickly in the field, have very limited shelf life, and become soft rendering them unsuitable for commercial shipping markets. The rind turns from green to burnt orange when ripe, while the flesh is white or pale orange. The ananas melon might provide a niche opportunity for roadside stands if consumer demand is established as this melon is a fragrant, sweet fruit with juicy flesh.

Another example of a melon type which is not well adapted for production and/or commercial shipping from North Carolina is the charentais. The charentais is a melon type commonly sold in Europe. The optimum eating quality in all the charentais melons we have examined to date is closely associated with splitting of the fruit. Fruit cracking has been reported to be a concern with other specialty melon types (Simon et al. 1993b). When harvested too early to avoid splitting of the fruit, the quality of fruit flavor and sweetness are inferior to fruit harvested at peak maturity. If premature splitting of the fruit cannot be overcome with an improved cultivar, perhaps development of specific cultural management practices for growing charentais melons in North Carolina might be successful, provided there is demand and growing the product is profitable. Growing under protected culture like tunnels or a greenhouse as cultured in Europe might be one possibility.

The soft epidermis of the fruit and the rapid break down of interior flesh in crenshaw melons does not make it a good candidate for the commercial shipping market.

Christmas/Piel de Sapo

Christmas or Piel de Sapo melons are a melon type that little breeding effort has been given, especially for humid growing regions like the southeastern United States. Most Christmas melons in the United States are grown in the drier southwestern United States. Several diseases affect melons, but can be especially troublesome under humid growing conditions (Elmstrom and Maynard 1992). Christmas melons take longer to mature than all the melon types we have tested (data not shown), thus they are exposed to potential plant pathogens for longer periods than most melon types. Shortening the growing season and a better visual cue to ensure harvest when fruit are at an optimum stage of development would increase the chances for success of this melon for commercial production in North Carolina.

Casaba and Juan Canary

Casaba melons have generally been difficult to grow in humid conditions due to no disease resistance, inferior flesh quality, and sunburn (Elmstrom and Maynard 1992). ‘Golden Beauty’ has produced moderate yields and excellent quality fruit when grown in North Carolina (data not shown). ‘MaryGold’, a casaba melon developed at the University of Maryland (Ng 1988), improved disease resistance with respectable yields and quality under wet growing conditions in Florida (Elmstrom and Maynard 1992). Juan Canary is a very similar type of melon with deficiencies which are similar to the casaba melon, but lacks the wrinkles which characterize the casaba melon.

Japanese Melons

As the name implies, the Japanese melon is a favorite melon grown in greenhouses in Japan. The fruit are packaged individually and cost approximately $50 each. Thus, the fruit is often given as a gift. The Japanese melon is another type of green flesh cantaloupe but it differs from the Galia type melons in several ways. The netting completely covers the fruit, while netting on a Galia melon type is more diffuse. The flesh
of a Japanese melon is firm while the flesh of a Galia melon is soft and creamy. A Japanese melon is generally sweeter than a Galia melon with total soluble solid readings on some melons reaching 16° or 17° Brix. These melons when mature must be cut from the vine since the fruit becomes soft and/or more prone to splitting if harvested when the abscission layer forms. It is often difficult to determine ripeness of the melon through visual cues as the background color changes only slightly from green to light green or cream. Because the Japanese melon is of very high quality, it has real market potential in the United States and other countries. However, the difficulty in determining ripeness and the publics’ unfamiliarity with this melon must be overcome. Often, seeds for Japanese types are obtained from seed companies in the Far East. We had identified ‘Emerald Jewel’ as a Japanese melon with excellent potential; however, dependable seed supply was a key limiting factor in pursuing any success with this melon.

**Galia Melons**

Galia type melons do hold some potential if the shelf life can be improved for the shipping market. We have evaluated many cultivars, and there are a few improved cultivars in which fruit size is more uniform, sweeter, and fruits that are larger than the standard cultivar ‘Gallicum’ that has been available and grown commercially for over a decade (Table 1). One of the cultivars which averaged 2.0 kg/fruit with total soluble solids readings consistently near 12 was ‘Sunny Gal’. ‘Golan 329’ had large, uniform fruit in 1999, but was much smaller in 2000. Both ‘Sunny Gal’ and ‘Golan 329’ also tend to have a smaller stem scar than the standard cultivars with potential for a longer shelf life than ‘Gallicum’. Moisture levels were maintained relatively high which may have resulted in lower sugar content as total soluble solid content has been reported to average between 13° and 14° Brix in high quality Galia melons (Simon et al. 1993a).

**Honeydew**

Honeydew melons are the second most consumed melon in the United States and are grown primarily in arid climates in the western United States or imported from Central America. Virtually no large areas of honeydew melons are produced in areas of high humidity and rainfall which typically occurs in the southeastern US. The high, irregular moisture conditions often lead to problems with disease and splitting or low fruit quality. New cultivars being developed might be better adapted to humid growing conditions. For example, yield and quality were quite good in tests conducted in 1999 and/or 2000 with several cultivars such as ‘Honey Star’, ‘Honey Gold’, ‘Millenium’, ‘Santa Fe’, and ‘Saturno’ (Table 1). Production of honeydew melon could provide an excellent opportunity for North Carolina growers to diversity since markets and public acceptance already exist. An additional advantage of producing honeydew on the east coast is the reduced shipping cost.

**Oriental Crisp-flesh Melons**

Oriental melons have been grown and consumed in the Far East for thousands of years, but are a relatively new melon to the people of the United States (Goldman 2002). There are two types of oriental melon. One type is sweet, the other more bland and often used for pickling. These melons are oblong or round, and yellow and or white when ripe, depending on cultivar. Fruits of most cultivars are relatively small averaging less than 1 kg (Table 1). In several cases, yield over 80,000 fruit/ha are common; however, typically only about 65% of the fruit are of marketable grade based on specifications that have been created. Most of the cultivars tested had soluble solids of 12° or 13° Brix; however, flavor was generally bland.

In one case, soluble solids for ‘Sprite’ melon averaged over 16° Brix with some fruit reaching 17° or 18° Brix (Table 1). The flavor of ‘Sprite’ melon resembles a pear and honey dew. ‘Sprite’ was included in 1998 as part of the melon screening program in the Specialty Crops program. After showing promise in screening trials in 1998 and 1999, the melon was grown on commercial farms. In 2000, two growers grew about 0.5 ha. The melon was well received at local roadside stands and by several commercial grocery store chains and demand for the melon increased dramatically in 2001. In 2001, approximately 60 acres were grown commercially in North Carolina by about 15 growers. Demand for the ‘Sprite’ melon in 2002 has doubled.
Table 1. Yield and quality comparisons of selected specialty melons grown in 1999 and 2000, Kinston, North Carolina.\textsuperscript{z}

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Fresh fruit yield</th>
<th>Avg. fruit size (kg)</th>
<th>Brix\textsuperscript{a}</th>
<th>Days to harvest from transplant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Galia type</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arava</td>
<td>53.2 --</td>
<td>37,119 --</td>
<td>-- 1.5</td>
<td>-- 11.8</td>
</tr>
<tr>
<td>Caruso</td>
<td>-- 67.6</td>
<td>-- 39,271 --</td>
<td>-- 1.6</td>
<td>-- 10.3</td>
</tr>
<tr>
<td>DPSX 656</td>
<td>-- 68.3</td>
<td>-- 51,645 --</td>
<td>-- 1.3</td>
<td>-- 11.4</td>
</tr>
<tr>
<td>DPSX 658</td>
<td>-- 63.2</td>
<td>-- 38,196 --</td>
<td>-- 1.6</td>
<td>-- 10.4</td>
</tr>
<tr>
<td>Gallicum</td>
<td>46.9 76.1</td>
<td>35,259 48,417</td>
<td>1.5 1.5</td>
<td>12.7 11.9</td>
</tr>
<tr>
<td>Galileo</td>
<td>44.6</td>
<td>38,732 --</td>
<td>-- 1.0</td>
<td>-- 12.9</td>
</tr>
<tr>
<td>Golan 329</td>
<td>49.5 63.6</td>
<td>32,278 51,107</td>
<td>2.0 1.3</td>
<td>10.4 11.6</td>
</tr>
<tr>
<td>Inbar</td>
<td>44.9</td>
<td>26,360 --</td>
<td>-- 1.6</td>
<td>-- 10.8</td>
</tr>
<tr>
<td>Passport</td>
<td>12.4 81.4</td>
<td>9,146 39,271</td>
<td>1.4 1.9</td>
<td>10.5 11.4</td>
</tr>
<tr>
<td>Pharis</td>
<td>-- 81.4</td>
<td>-- 52,183 --</td>
<td>-- 1.5</td>
<td>-- 11.5</td>
</tr>
<tr>
<td>SNX 7332</td>
<td>42.1</td>
<td>41,422 --</td>
<td>-- 1.2</td>
<td>-- 11.8</td>
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<tr>
<td>Sunny Gal</td>
<td>39.0 70.5</td>
<td>25,285 39,271</td>
<td>2.0 1.8</td>
<td>11.0 12.3</td>
</tr>
<tr>
<td>SXM 5080</td>
<td>40.5 --</td>
<td>31,740 --</td>
<td>-- 1.2</td>
<td>-- 11.8</td>
</tr>
<tr>
<td>SXM 5093</td>
<td>38.6 67.9</td>
<td>25,285 40,347</td>
<td>1.6 1.5</td>
<td>11.4 11.3</td>
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<tr>
<td><strong>Honeydew type</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Crème De</td>
<td>66.4</td>
<td>27,975 --</td>
<td>-- 2.1</td>
<td>-- 12.6</td>
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<tr>
<td>Menthe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMX 5591</td>
<td>33.6</td>
<td>12,911 --</td>
<td>-- 2.6</td>
<td>-- 11.9</td>
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<tr>
<td>Honey Brew</td>
<td>66.2 73.2</td>
<td>21,519 32,278</td>
<td>3.0 2.4</td>
<td>12.3 14.4</td>
</tr>
<tr>
<td>Honey Gold</td>
<td>-- 62.7</td>
<td>-- 32,816 --</td>
<td>-- 1.9</td>
<td>-- 13.6</td>
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<tr>
<td>Honey Star</td>
<td>56.3 79.7</td>
<td>19,365 34,968</td>
<td>2.8 2.3</td>
<td>15.0 14.0</td>
</tr>
<tr>
<td>Megabrew</td>
<td>77.8 90.7</td>
<td>29,588 38,735</td>
<td>2.7 2.3</td>
<td>11.2 12.1</td>
</tr>
<tr>
<td>Millenium</td>
<td>-- 76.0</td>
<td>27,437 --</td>
<td>-- 2.5</td>
<td>-- 15.0</td>
</tr>
<tr>
<td>Moon Melon</td>
<td>50.3</td>
<td>31,740 --</td>
<td>-- 1.6</td>
<td>-- 14.6</td>
</tr>
<tr>
<td>Rocio</td>
<td>54.6</td>
<td>19,980 --</td>
<td>-- 2.9</td>
<td>-- 12.3</td>
</tr>
<tr>
<td>Santa Fe</td>
<td>54.6 24.8</td>
<td>22,057 12,911</td>
<td>2.4 1.9</td>
<td>16.5 14.7</td>
</tr>
<tr>
<td>Saturno</td>
<td>-- 63.2</td>
<td>-- 36,045 --</td>
<td>-- 2.7</td>
<td>-- 13.6</td>
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<tr>
<td>SXM 7051</td>
<td>30.8</td>
<td>22,596 --</td>
<td>-- 2.8</td>
<td>-- 12.9</td>
</tr>
<tr>
<td>SXM 7061</td>
<td>44.8</td>
<td>17,216 --</td>
<td>-- 2.9</td>
<td>-- 11.2</td>
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<tr>
<td>Tesora Dulce</td>
<td>44.6 60.5</td>
<td>23,132 26,898</td>
<td>2.0 2.2</td>
<td>12.0 11.6</td>
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<tr>
<td><strong>Oriental crisp-flesh type</strong></td>
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<td></td>
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<tr>
<td>Gold Star</td>
<td>40.3 32.9</td>
<td>71,013 61,866</td>
<td>0.5 0.5</td>
<td>14.4 15.2</td>
</tr>
<tr>
<td>Master</td>
<td>18.7 32.1</td>
<td>18,290 43,037</td>
<td>1.2 0.8</td>
<td>13.7 12.4</td>
</tr>
<tr>
<td>RML 5012</td>
<td>-- 42.3</td>
<td>-- 104,903 --</td>
<td>-- 0.4</td>
<td>-- 9.7</td>
</tr>
<tr>
<td>RML 5013</td>
<td>-- 30.4</td>
<td>-- 58,099 --</td>
<td>-- 0.5</td>
<td>-- NDw</td>
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<tr>
<td>Sprite</td>
<td>46.0 41.7</td>
<td>84,998 89,841</td>
<td>0.5 0.7</td>
<td>16.3 17.2</td>
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<tr>
<td>SRM 7085</td>
<td>-- 41.7</td>
<td>-- 17,216 --</td>
<td>-- 2.3</td>
<td>-- 12.4</td>
</tr>
<tr>
<td>Yellow Queen</td>
<td>31.7</td>
<td>67,246 --</td>
<td>-- 0.5</td>
<td>-- NDw</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Nonreplicated, observational studies, planted May 21, 1999 and May 1, 2000.

\textsuperscript{b}--: Indicates that melon cultivar or line was not grown in a given year.

\textsuperscript{c}Based on five melons per cultivar or line.

\textsuperscript{d}ND; Indicates no data were taken.
CONCLUSIONS

Some of the keys to the initial successes of the melon screening program are having all elements in the program working together. Research and development involving field screening is necessary to determine if a melon is adapted to North Carolina growing conditions, and possesses some unique qualities worthy of marketing consideration. The marketing component is critical to assess buyer interest and for the promotion of a new product once interest is indicated. Marketing and field research are conducted simultaneously to help eliminate some of the risk to producers and streamline the process so that producers can more quickly add new crop items. Ultimately, active participation by the grower in producing a new product is critical to the success of the melon screening program. Finally, exchanging the latest information and continual assessment of new melons by the marketers, researchers, extension workers, and growers is critical to the long term success of the specialty melon program.

REFERENCES


