

## **Yield, Income, Quality, and Blotchy Ripening Susceptibility of Staked Tomato Cultivars in Central Kentucky**

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Kentucky growers currently produce about 1200 acres of staked, vine-ripe tomatoes for local and national markets. Kentucky tomatoes have an excellent quality reputation among buyers in several midwestern states. We last tested fresh market tomatoes in 1998-99 to evaluate new and existing commercial cultivars and to identify any that might be featured in supermarkets as a premium “Kentucky Tomato”. We evaluated cultivars for yields, appearance, firmness, and taste and compared them with well-established cultivars like Mountain Spring and Mountain Fresh. We were looking specifically for the following characteristics in the “Kentucky Tomato”:

1. large slicer that tastes good
2. ships reasonably well (firm, but not necessarily the most firm among cultivars)
3. high yields of extra-large and jumbo size classes
4. low frequency of fruit defects

Varieties in that trial were again evaluated for these traits (except for taste) in 2004. Two varieties were included with resistance to tomato spotted wilt virus (TSWV), which has become a major problem in some neighboring states. See the tomato cultivar trial report from eastern Kentucky in this issue of the *Research Report* for detailed descriptions of the varieties tested.

In recent years growers in some parts of the state have had more blotchy ripening (BR) and related ripening disorders. An abnormally wet, cool and cloudy spring and summer in 2004 resulted in extensive BR among some of the cultivars in the trial. This provided a rare opportunity to compare occurrence of the disorder among varieties.

### **Materials and Methods**

A carefully selected group of 12 determinate tomato varieties from several seed companies was evaluated at Lexington in central Kentucky and at Quicksand in eastern Kentucky (see separate report). Two popular cultivars, Mountain Spring and Mountain Fresh, were included for comparison with new cultivars. All trial entries were seeded in the greenhouse at the Horticultural Research Farm on 16 April and subsequently transferred to 72-cell plastic trays. Cultivars were transplanted to the field on 25 May. Cultivars were planted in a randomized complete block design with four replications. Plots consisted of eight plants spaced 18 in. apart in single rows on 6-in. high raised beds spaced 6 ft. apart with black plastic mulch and trickle irrigation.

Drip irrigation was applied as needed according to tensiometers used to monitor soil moisture. Plants were staked and tied using the Florida weave system and pruned to two main stems. Sixty pounds/acre of nitrogen, no phosphorus, and 108 lbs/acre of potassium (K<sub>2</sub>O) were applied prior to bed formation. A total of 54 lbs/acre of supplemental N (from ammonium nitrate) was

fertigated in 11 applications during the season. Plots were sprayed weekly with protectant fungicides (copper plus Maneb, alternated with copper plus either Bravo or Quadris). Three insecticide sprays (Asana or Baythroid) were required during the season.

Ten harvests were made from 28 July until 28 Sept. Fruit were graded into the following size classes prior to counting and weighing: Jumbo (>3.5 in. diameter), extra-large (>3 in. but ≤ 3.5 in.), large (>2.5 in. but ≤3 in.), medium and small (≤2.5 in) and cull. Fruits were also sorted according to U.S. No. 1 or U.S. No. 2 grades. In order to approximate the present marketing situation in Kentucky, “marketable yield” included only the “large” and above size classes. Yields of the “medium” size class are reported together with the small class as they are not considered worth marketing by most grower/shippers in the state. All yields reported are of U.S. No. 1 fruit unless otherwise indicated. Yields of No. 2 fruits, although marketable in most years, were not included in “marketable yield” and are reported in separate columns in the tables. Means of all variables were compared using Waller-Duncan’s K-ratio T-test (P = 0.05).

**Income-per-acre.** In addition to reporting yields in pounds or cartons per acre, variety performance is also expressed as income per acre. The 2004 prices received at Cumberland Farm Products Cooperative were very low compared to the previous five years, and prices were not available after 29 July. In addition, there were few differences in prices among early and later harvest dates. For these reasons we used 2003 prices (Table 1), similar to those from 1999-2002. These weekly market prices were multiplied by yields from the different size classes for each variety. Higher prices used for the first three weeks of harvests favor earlier-maturing varieties. Higher prices were also obtained for the “extra large/jumbo” size class. Yields of No. 2 fruits were also used in these calculations but usually with lower prices than No. 1 fruits. We consider the incomes per acre together with fruit quality observations to provide the best indication of overall variety performance.

**Fruit quality ratings.** A representative sample of about 100 ripe fruits of each variety harvested on 11 Aug. (4<sup>th</sup> harvest) were laid out for careful examination and quality ratings on 18 Aug. All cultivars were rated for smoothness, blossom scar size, extent of cracking, firmness, and internal color. The overall appearance rating took most of these factors into account.

**Blotchy ripening.** BR was observed in most varieties, especially during the first five harvests. In order to compare varieties for susceptibility to BR, all fruits from 4 replications were combined after grading and the numbers of fruits with BR symptoms were recorded. Prior to counting, fruits were held at room temperature for 7 to 12 days after harvest in commercial 25 lb tomato boxes.

## Results and Discussion

The 2004 growing season was abnormally wet, cool and cloudy. The trial was planted later than usual because of rains and seed germination problems with some varieties. We believe the unusual weather led to a greater than normal amount of cull fruit (26-63%), due to catfacing and other defects, in the earlier harvests. In addition, many fruit were culled because of a significant amount of BR. It is a poorly understood disorder, but often occurs after long periods of cloudy

weather. BR has also been associated with nutrient imbalances (especially low potassium relative to nitrogen in mineral soils) which can occur as a result of nutrient uptake problems.

The pre-plant soil potassium levels were high (310 lbs/acre), and soil P levels were very high (95 lbs/acre). Calcium and magnesium levels were also high (3046 and 385 lbs/acre, respectively). Lime (1 ton/acre) and 108 lb K<sub>2</sub>O/acre (from KCl) were applied prior to transplanting. The Hartz ratio (see [www.oardc.ohio-state.edu/tomato/ysd/newhartzratio.htm](http://www.oardc.ohio-state.edu/tomato/ysd/newhartzratio.htm)), used as an indicator of soil conditions that might result in tomato ripening disorders, was calculated based on our pre-plant soil test results. The ratio was 0.37 (prior to the potassium application) which is slightly over the 0.35 threshold level (Soils in the Midwest may be prone to ripening disorders when Hartz ratios are *less than* 0.35). The extremely long cloudy period was probably the most significant factor contributing to blotchy ripening in the trial. The disorder was also widely reported statewide in 2003 and 2004. Foliar disease control was excellent and there were no significant disease problems.

**Yields and Incomes.** The highest yielding cultivars were Mountain Fresh, Mountain Spring, BHN 591, Sunguard, Mountain Crest, BHN 543, and Amelia (Table 2). Incomes per acre were lower this year than in 1998-99 because of unfavorable weather and lower yields. Incomes ranged from \$8992/acre for Sunguard to \$5947/acre for Sunchief (Table 2). Among the highest yielders, Sunguard and Mountain Crest had the highest per-acre incomes followed by BHN 591, Mountain Spring, BHN 641 (yellow-fruited), Mountain Fresh, BHN 543, and Amelia (Table 2).

**Fruit quality.** Among the highest yielding and highest income varieties, Sunguard, Mountain Crest, Amelia, and BHN 641 (yellow) had the best fruit appearance scores (Table 3). BHN 543 also had a relatively high appearance score although it had more radial cracking than most varieties tested; Mountain Fresh also had more fruits than usual with radial cracking. Sunchief, Sebring, and BHN 591 had the worst appearance scores in the trial (Table 3).

**Blotchy ripening.** Although BR occurred in all cultivars, some were much more susceptible than others (Table 4). The average percentage of fruits affected over 5 harvests ranged from 59% (Sebring) to 4% (Sunguard and Mountain Crest) while the overall trial average was 16%. Sebring and Sunchief were the worst affected and will not be tested further. Most varieties appeared to be moderately susceptible (7-12%) while Mountain Crest and Sunguard were the least susceptible (Table 4).

**All things considered.** Sunguard was one of the most promising cultivars in this trial and in trials conducted in south central Kentucky in 2003 (see 2003 Research Report). Mountain Crest, a new variety with extended shelf life and dark red internal color, rated very well for yields, quality, and BR tolerance. These two varieties, Amelia, BHN 543, and BHN 641 (yellow) will be tested again in 2005. Sunguard and Mountain Crest deserve on-farm testing alongside well-established varieties like Mountain Fresh or Mountain Spring.

Table 1. Actual farm gate prices paid by Cumberland Farm Products Cooperative in 2003.

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| #1 Jumbo & X-large | #1 Large | #2's (Jumbo,X- |
|--------------------|----------|----------------|
|--------------------|----------|----------------|

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| Week ending                 | Ig,Lg,Med)                |        |        |
|-----------------------------|---------------------------|--------|--------|
|                             | -----price per pound----- |        |        |
| 22 July                     | \$0.34                    | \$0.21 | \$0.22 |
| 29 July                     | 0.30                      | 0.17   | 0.22   |
| 5 Aug                       | 0.29                      | 0.15   | 0.19   |
| 12 Aug                      | 0.20                      | 0.11   | 0.09   |
| 19 Aug                      | 0.12                      | 0.09   | 0.08   |
| 20 Aug-28 Sept <sup>z</sup> | 0.10                      | 0.05   | 0.06   |

<sup>z</sup>Cumberland Farm Products Cooperative discontinued packing on 19 August. We used prices slightly lower than their 19 Aug prices for income calculations for all trial harvests after that date.

Table 2. Yields, fruit size, and income from staked tomato cultivars at Lexington, Kentucky, 2004; all data are means of four replications.

| Entry<br>(Seed Source)          | ---#1 Jumbo+XL <sup>1</sup> ---- |    | Tot.<br>mkt <sup>2</sup> | # 2's <sup>3</sup> | Culls% <sup>4</sup> | Avg. frt. wt.<br>oz. <sup>5</sup> | Income<br>\$/acre |
|---------------------------------|----------------------------------|----|--------------------------|--------------------|---------------------|-----------------------------------|-------------------|
|                                 | boxes/acre                       | %  | thousand lbs/acre        |                    |                     |                                   |                   |
| Mtn. Fresh (HM)                 | 1321                             | 55 | 59.7                     | 24.9               | 26                  | 9.8                               | 7989              |
| Mtn. Spring (RG)                | 1289                             | 60 | 54.2                     | 18.2               | 36                  | 10.3                              | 8260              |
| BHN 591 (BHN)                   | 1283                             | 60 | 52.9                     | 28.6               | 36                  | 10.3                              | 8808              |
| Sunguard (SM)                   | 1278                             | 61 | 52.5                     | 21.0               | 38                  | 10.4                              | 8992              |
| Mtn. Crest (SU/RU)              | 1261                             | 61 | 52.1                     | 20.6               | 38                  | 10.4                              | 8912              |
| BHN 543 (BHN)                   | 1252                             | 76 | 41.7                     | 27.2               | 48                  | 11.6                              | 7949              |
| Amelia (HM)                     | 1207                             | 65 | 46.2                     | 22.3               | 41                  | 10.5                              | 7946              |
| BHN 641 (yellow)                | 983                              | 60 | 41.5                     | 28.8               | 41                  | 10.4                              | 7989              |
| Sebring (RG)                    | 901                              | 70 | 32.1                     | 23.3               | 49                  | 10.6                              | 6035              |
| FL 7514 (SW)                    | 875                              | 50 | 43.5                     | 19.2               | 38                  | 9.4                               | 7376              |
| BHN 444 (BHN)                   | 843                              | 70 | 30.1                     | 24.3               | 53                  | 11.1                              | 7276              |
| Sunchief (SM)                   | 527                              | 67 | 20.0                     | 18.0               | 63                  | 10.7                              | 5947              |
| Waller-Duncan<br>LSD (P = 0.05) | 277                              | 12 | 9.3                      | 5.1                | 7.5                 | 0.9                               | 1156              |

<sup>1</sup>Yields of USDA No. 1 fruit of jumbo (>3.5 in. diameter) *plus* extra large (>2.75 in. but ≤ 3.5 in.) size classes; boxes/acre = number of 25 lb cartons per acre; “%” = percentage of the total of these two size classes of the *total marketable yield*.

<sup>2</sup>Total marketable yield = yield of No. 1 fruit of jumbo + extra large + large size classes; mediums not included.

<sup>3</sup>Yield of USDA No. 2 fruit from all size classes.

<sup>4</sup>Percentage of culled fruit in total yield.

<sup>5</sup>Average fruit weight; includes jumbo, extra large, and large only.

Table 3. Fruit quality characteristics; observations from all red-ripe fruits harvested from one replication on 11 August, 2004. Cultivars ranked in order of yield of #1 Jumbo+Extra Large fruits.

| Cultivar (Seed Co.) | Shape | Blossom scar <sup>2</sup> | Smoothness <sup>3</sup> | Cracking <sup>4</sup> | Appearance <sup>5</sup> | Firmness <sup>6</sup> | Internal Color <sup>7</sup> | Comments                                   |
|---------------------|-------|---------------------------|-------------------------|-----------------------|-------------------------|-----------------------|-----------------------------|--|
| Mtn. Fresh          | do    | s                         | 2                       | 2                     | 7                       | m                     | 4                           |  |
| Mtn. Spring         | o-do  | s                         | 3                       | 2                     | 7                       | f                     | 3                           |  |
| BHN 591             | o-do  | m                         | 3                       | 2.5                   | 5                       | m                     | 4                           | rough; large stem end scar                 |
| Sunguard            | do    | m                         | 2.5                     | 1.5                   | 8                       | f                     | 4                           | very attractive; nice internal color       |
| Mtn. Crest          | do    | m                         | 2                       | 1.5                   | 7                       | f                     | 4                           | smooth; nice internal color                |
| BHN 543             | do-g  | m                         | 2.5                     | 3                     | 6.5                     | m                     | 3                           | large stem end scar                        |
| Amelia              | do    | s                         | 2.5                     | 1.5                   | 7                       | m                     | 3                           |  |
| BHN 641 (yellow)    | do-g  | m                         | 2                       | 2.5                   | 6.5                     | f                     | 3                           |  |
| Sebring             | do-g  | s                         | 2                       | 1.5                   | 4                       | f                     | 3                           | serious blotchy ripening this harvest date |
| FL 7514             | do    | m                         | 3                       | 2                     | 6                       | s                     | 3                           | some internal white tissue                 |
| BHN 444             | g     | m                         | 2                       | 3                     | 6                       | m                     | 2                           |  |
| Sunchief            | o     | s                         | 4                       | 3                     | 3                       | m                     | 3                           | rough; blotchy ripening this harvest date  |

<sup>1</sup>Fruit shape: o = oblate; do = deep oblate (diameter somewhat greater than height); g = globe (spherical); dg = deep globe.

<sup>2</sup>Blossom scar size: s = small (< 1/8 in. diameter), m = medium (1/8 to 1/4 in.), lg = large (5/16 to 7/16 in.).

<sup>3</sup>Smoothness of fruit shoulders: 1 = smooth, 5 = rough (ribbed on top of fruit).

<sup>4</sup>Fruit cracking: 1 = none, 5 = severe.

<sup>5</sup>Overall fruit appearance rating: 1 = worst, 9 = best.

<sup>6</sup>Fruit firmness by feel: s = soft, m = medium firm, f = very firm.

<sup>7</sup>Internal fruit color: 1 = whitish (worst), 5 = uniformly deep red (best).

Table 4. Percentages of fruits with blotchy ripening from first 5 harvests; observations from red-ripe fruits combined from all 4 replications, 28 July to 18 August, 2004. Cultivars ranked from worst (most blotchy ripening) to best (least blotchy ripening).

| Cultivar (Seed Co.) | Harvest dates                                  |     |     |      |      | Average   |
|---------------------|--|-----|-----|------|------|-----------|
|                     | 7/28   | 8/2 | 8/5 | 8/11 | 8/18 |           |
|                     | --% of fruits with blotchy ripening symptoms-- |     |     |      |      |           |
| Sebring             | 73   | 37  | 45  | 43   | 95   | <b>59</b> |
| Sunchief            | 48   | 12  | 43  | 73   | 44   | <b>44</b> |
| BHN 444             | 27   | 1   | 0   | 0    | 32   | <b>12</b> |
| BHN 543             | 22   | 0   | 0   | 0    | 39   | <b>12</b> |
| FL 7514             | 39   | 0   | 0   | 0    | 19   | <b>11</b> |
| Amelia              | 46   | 1   | 0   | 0    | 8    | <b>11</b> |
| BHN 641 (yellow)    | 37   | 9   | 2   | 0    | 0    | <b>10</b> |
| BHN 591             | 14   | 0   | 0   | 0    | 30   | <b>9</b>  |
| Mtn. Spring         | 12   | 2   | 0   | 0    | 29   | <b>9</b>  |
| Mtn. Fresh          | 29   | 0   | 0   | 0    | 8    | <b>7</b>  |
| Mtn. Crest          | 4  | 3   | 0   | 0    | 16   | <b>4</b>  |
| Sunguard            | 13   | 0   | 0   | 0    | 8    | <b>4</b>  |