Optimizing Fruit Quality in Fresh Market Tomatoes
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Optimizing Fruit Quality in Fresh Market Tomato

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Attention to improving the quality and appearance of fruit is the foundation for success in fresh market tomatoes because skin color, firmness and an attractive appearance are crucial for market acceptance. Tomato fruit quality and appearance are determined by a wide range of factors. Among these, key factors are the variety, cultural management practices and seasonal weather. Information is presented here on variety choice and production practices that can help improve the quality and appearance of fresh market tomato fruit.

This bulletin focuses on how to reduce fruit cracking and shoulder check defect, and how to improve fruit color. Information on management of other tomato fruit disorders such as blossom-end rot and

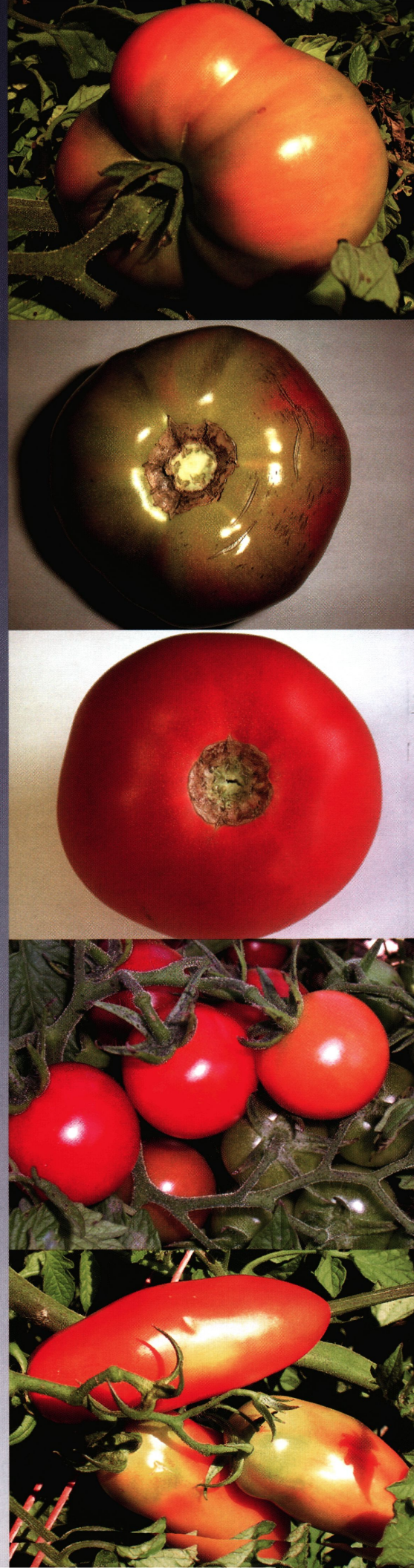

Figure 1. This continuum shows the trend from the heirloom varieties at the top, which are generally susceptible to cracks, to less crack-susceptible and more acceptable-looking Roma-type varieties at the bottom.

catface are available from other sources, including those listed here. An excellent overview of tomato fruit physiological defects such as catface is presented in MSUE Extension bulletin E-1679 (Stephens et al., 1983) and from the Texas Cooperative Extension Web site: **http://aggie-horticulture.tamu.edu/tomatoproblemsolver/index.html**. Recent information on control of blossom-end rot is presented by Arden Sherf and Thomas Woods of Cornell University at **http://vegetablemdonline.ppath.cornell.edu/factsheets/tomato_blossrt.htm**.

Fruit Cracking and Shoulder Check Defect

Variety choice. Varieties vary greatly in susceptibility to cracking, physiological defects and deformities. Varieties are often classified according to fruit type, from the fresh market standard round to the moderate-sized, elongated Roma-type varieties (often referred to as paste, plum or saladette), and the smaller grape or cherry tomatoes. Heirloom varieties are specialty types of tomato that have been grown for many years, often for more than 100 years, and they offer unusual shapes, colors and flavors.

It is difficult to generalize about such a wide range of tomato types, but varieties that have been bred and selected for commercial production tend to have improved transport and storability characteristics, including fruit firmness and a thick, elastic epidermis (skin or peel of the fruit). Roma varieties are produced for processing into paste as well as fresh market use and tend to have very firm fruit with high solids (that is, low water content).

In contrast to commercially grown fresh market varieties, heirloom varieties tend to have thin skins and be highly susceptible to cracking. Figure 1 shows general trends in fruit quality by variety. Fruit firmness and appearance are generally superior in Roma and cherry types; heirloom varieties are often susceptible to fruit quality disorders and cracking. Fresh market tomato varieties currently grown commercially in the Great Lakes region vary in susceptibility to cracking and fruit disorders. Varieties that were released over two decades ago, such as 'Celebrity', tend to be more sensitive to weather-induced cracking and physiological defects than more recently released varieties such as 'Mountain Spring'. 'Celebrity' and 'Mountain Spring' are both highly productive, vigorous and determinant varieties adapted to diverse environments.

Our research at MSU indicates that, under Michigan conditions, careful water and fertility management is essential to reduce fruit cracking in 'Celebrity'. By contrast, 'Mountain Spring' has been selected for resistance to fruit cracking and consistently produces fewer cracked fruit than 'Celebrity'. 'Mountain Spring' is the most widely used commercial fresh market tomato variety in Michigan because of its production of large, firm fruit with few radial or growth cracks. Unfortunately, both varieties are susceptible to the fruit defect known as shoulder check. Figure 2 shows this defect, which has recently become a major problem in southern Michigan fresh market tomato production.

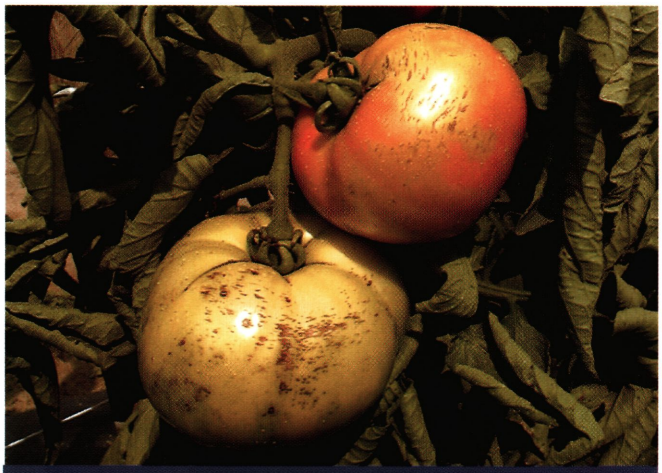

Figure 2. Shoulder check on fresh market tomato fruit. The defect involves multiple tiny, frequently parallel cracks on the shoulders of the fruit.

Cultural management. Fruit cracks and shoulder check defect can cause serious losses in marketable fruits, depending in large part on weather conditions. Larger fruit tend to be more susceptible to cracking injury. High rainfall years are problematic for crack injury, particularly if the rainfall occurs late in the growing season. The single best control for cracking is a constant and regular water supply. This is achieved in part through the use of drip irrigation. It is difficult to achieve complete control of soil water status in high rainfall summers, but use of mulch will mediate soil moisture fluctuation. Use of either a plastic or an organic mulch is associated with reduced fruit cracking and is a recommended practice.

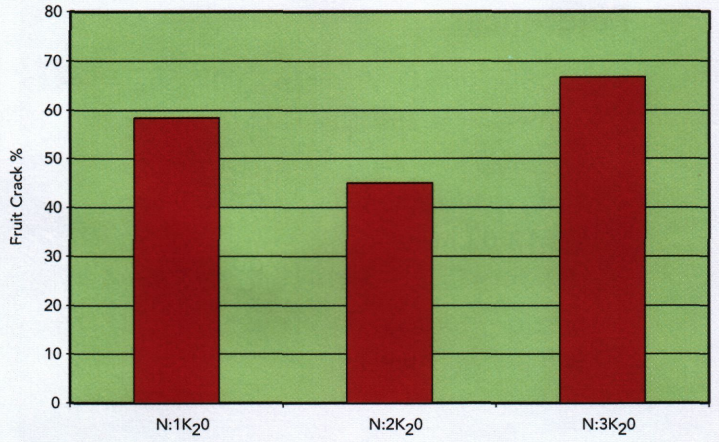

Figure 3. In our recent field experiments, cracking in fruit is consistently lowest for tomatoes fertigated at a ratio of N:2 K_20.

Like fruit cracks, shoulder check defect is a serious problem in growing seasons that have alternating periods of hot, dry weather and rainfall during the time of rapid fruit expansion. In southern Michigan, the weather conducive for shoulder check tends to occur in late August and early September.

Recent experiments in southwestern Michigan indicate the importance of giving careful consideration to the nitrogen to potassium ratio (N:K_20) in the nutrition program. On a site with high fertility soil, a ratio of N:1 K_20 may produce high quality fruit, but on a low fertility or low organic matter site, increasing the amount of potassium to achieve a ratio of N:2 K_20 or of N:3 K_20 in fertigation applied during fruit filling will tend to increase the potassium in the fruit. This, in turn, tends to enhance fruit firmness. Fruit firmness in many cases is closely associated with reduced shoulder check defect and less fruit cracking overall. In our experiments, a ratio of N:2 K_20 achieved the lowest crack incidence in fruit assayed from field experiments (Figure 3).

Other nutrients that influence fruit quality include calcium and boron. Our research at Michigan State University indicates that application of boron foliar sprays during the late fruit fill period can improve yields of marketable fruit and fruit quality by decreasing the incidence of shoulder check. This was observed in some but not all field experiments carried out (Figure 4). When spraying calcium or boron, the critical plant part for coverage is the fruit, particularly the stem end. Coverage needs to begin just before the mature green stage and continue throughout fruit expansion. Spraying once a week or, ideally, after every rain event has been a successful strategy.

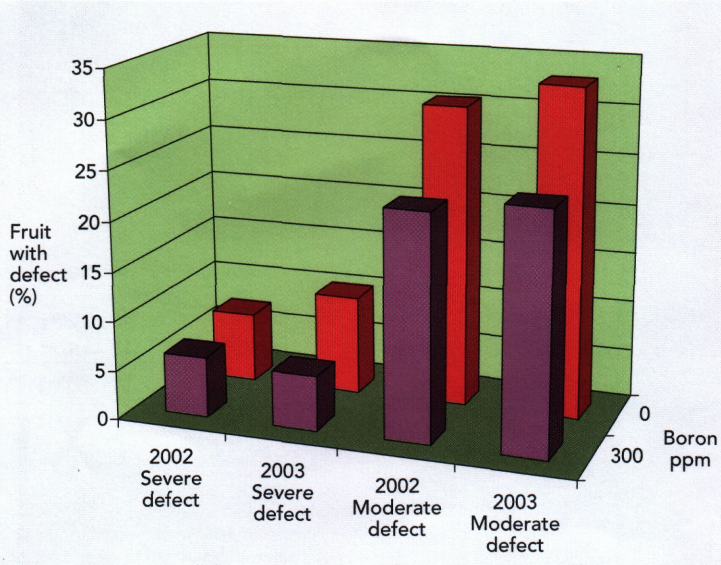

Figure 4. The percentage of fruit with shoulder check defect, either severe (over 10% check incidence) or moderate check defect (10% or less check incidence). Plants that were foliar sprayed with 300 ppm boron tended to have fewer fruits with defects (blue bars) than plants sprayed with water (red bars).

Boron is a micronutrient that should not be over-applied. Applied in excess, it can cause physiological defects. Do not apply more than 0.25 pound of actual boron per acre per foliar spray, and be cautious of multiple applications of boron. There are a large number of fertilizer sources of boron on the market, such as Borax (13.4% boron) and Solubor (20.5% boron). In our experiments, late- season calcium foliar sprays also showed fruit quality benefits in some cases but not in all. A modest reduction in shoulder check defect was frequently associated with calcium or calcium plus boron foliar sprays (Figure 5).

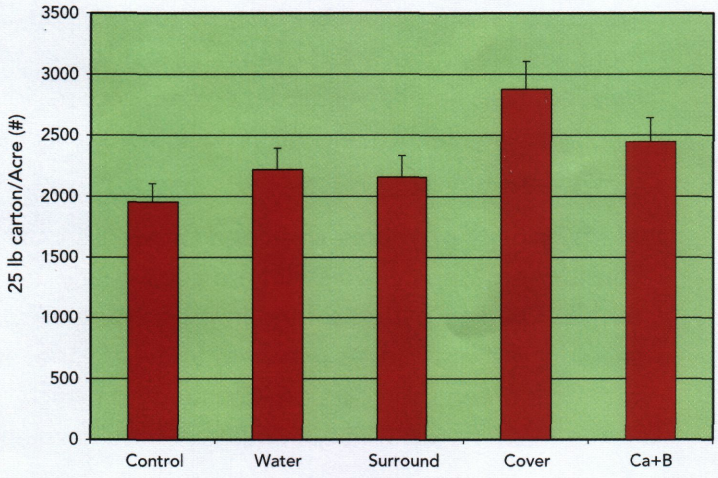

Figure 5. A comparison of cultural treatments applied to improve yield of marketable, high quality fruit without cracks or shoulder check defect. The control was not treated. The water treatment was a weekly foliar application of water; the Surround treatment was a weekly foliar application of Surround™ WP (95% kaolin); the cover treatment was a plastic tunnel shown in Figure 6; and the Ca+B treatment was a weekly foliar application of calcium (0.2%) and boron (0.03%). The plastic cover and calcium+boron foliar spray were the only treatments that increased the number of marketable fruit cartons per acre.

Plant nutrition is the key to improving fruit appearance, but there are other cultural practices to consider. It is important to follow recommended pruning practices that enhance air circulation and promote uniform growth. In Michigan, the recommendation is to prune to one sucker below the first flower cluster for fresh market tomato production. A very expensive but unusually effective means to optimize fresh market tomato fruit quality is to erect high tunnels or plastic covers in the field to protect fruit from rain splash and to provide some frost protection (figures 5 and 6).

Fruit Color

Poor color generally translates into less nutritious fruit because the pigments that make tomato fruit red are provitamin A and lycopene. Color disorders can affect as much as 50 percent of the tomato crop. Yellow and white shoulder disorders are common color problems. The severity of symptoms ranges from internal white tissue to distinct yellow or green sectors. Because of this variability, quality defects are sometimes called by different names, from yellow eye, green shoulder, yellow tag and internal white tissue to yellow shoulder. Yellow shoulder involves modified development with reduced cell size and random orientation, and the green chloroplasts fail to develop red pigments.

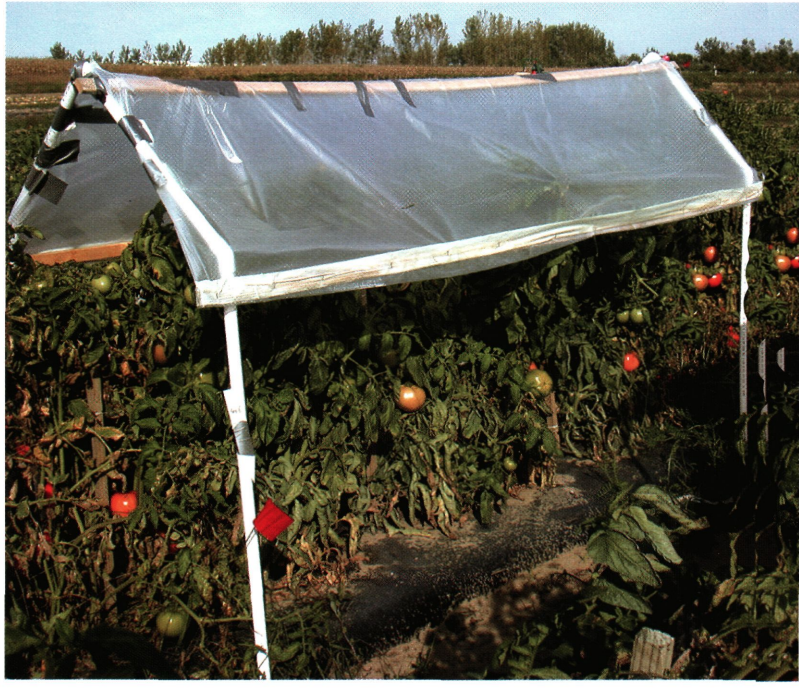

Figure 6. Plastic shield or high tunnel used to research fruit quality.

These alterations occur very early in fruit development and are not reversed even if harvest is delayed. Delaying harvest to let colored sectors catch up is ineffective and will reduce the quality of unaffected fruit.

Management of yellow shoulder. Growers should consider growing cultivars that are consistently uniform in ripening patterns if the fruit disorder yellow shoulder is a problem. It may help to avoid varieties with dark green shoulders on immature fruit, such as the fresh market variety 'Mountain Pride'.

Soil quality also influences color quality and yellow shoulder in fresh market tomatoes (Snapp and Warncke, 2003). Soil pH, available potassium, magnesium, calcium and soil organic matter are all important factors in tomato fertility management and optimizing fruit quality. Uniform color requires more available potassium than is necessary for yield alone. Recent research in California suggests that soil application of either potassium or gypsum to increase the ratio of available potassium to magnesium can reduce color disorders if the soil does not have a high potassium fixation capacity.

Figure 7. The color disorder yellow shoulder in a fresh market tomato.

Research conducted at Ohio State University documents the important roles for soil organic matter and pH. For recent research results from Ohio on tomato color, see <**http://www.oardc.ohio-state.edu/tomato/managingcolor.htm**>. Tomatoes grown on soils containing greater than 3.4 percent organic matter produce fruit with a low incidence of yellow shoulder disorder; tomatoes grown on soils with organic matter below 2.4 percent produce fruit with a high incidence of yellow shoulder disorder. In Ohio, it was found that tomatoes produced on soil with a pH at or below 6.4 have a low incidence of yellow shoulder, and tomatoes grown on soil with a pH above 6.7 have a high incidence.

The future of tomato fruit quality

Tomato plant breeders are working to improve the genetic potential for superior fruit quality. Look for new varieties that have not only improved color and resistance to cracking but also enhanced health properties. Tomato fruit have healthful phytochemicals such as lycopene, an antioxidant that has been associated with prevention of the damage to human cells caused by aging and disease. Recent germ plasm improvements have led to approximately threefold increases in lycopene content. Research is also under way on biochemical compounds that contribute to uniform red color for superior fruit appearance. Translating research findings into varieties that have commercial viability is a long-term process, but varieties are in the pipeline that show potential as producers of high quality, healthful fruit.

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Project GREEEN

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