MANDARIN FRUIT QUALITY

Publication Number
31-017C
(February 2010)

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Foothill mandarins are renowned for flavor and sweetness. Most are direct marketed to discerning consumers who expect excellent flavor and quality. Maintaining quality is critical to the reputation of the Mountain Mandarin® and the future of the industry.

Fruit Quality Factors

A number of factors play into what the consumer sees as citrus fruit quality. These may include:

1. Size
2. Shape
3. Color
4. Overall appearance
5. Peel smoothness
6. Ease of peeling
7. Seedlessness
8. Ratio of soluble solids (mostly sugars) to acid
9. Flavor or taste

Standards set by the USDA and followed in California are minimum standards, and rely principally on visual characteristics. Minimum legal maturity is set at 8:1; 8% soluble solids (Brix) to 1% acids. As fruit mature, sugars rise and acids decline, creating the balance of sweetness and acid that is prized in Satsuma mandarins. Mandarins at minimum legal maturity are very sour, and not what Mountain Mandarin® consumers expect. Selling fruit that only meets minimum legal standards damages the reputation and longevity of the Mountain Mandarin as a high value, niche market fruit. Mountain Mandarin standards ***must*** be higher than legal minimums.

Standard Pack Regulations

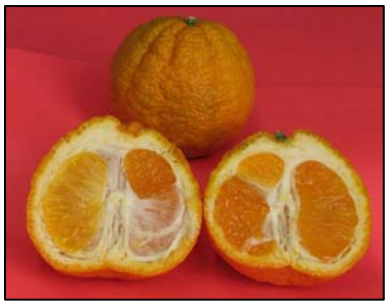
Fruit sold to distributors or most stores must meet standard pack regulations. That is:

- Fruit fairly uniform in size
- Packed in boxes or cartons, arranged according to approved methods
- Tightly packed and well filled but not overfilled so as to cause "excessive or unnecessary bruising"
- Container shall be at least level full at time of packing

Fruit Defects

Defects in mandarin fruit are due to a number of factors. Some are beyond the control of growers, but others are the result of poor cultural practices. Mandarin defects that affect quality parameters include:

- Rough or thick skin



- Misshapen fruit

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- Rind breakdown

Rind breakdown is a weather-related physiological disorder. It occurs when rain coincides with sudden temperature decreases. The oil glands in the skin release their oil under the cuticle, leaving soft, dark areas on the fruit surface.

Generally, rind damage is greater on fruit on the outside of trees and on the exposed side of the fruit. Rind damage decreases shelf life and affects fruit quality if fruit is stored

- Rind Breakdown & Rot

Opportunistic fungi or bacteria may infect after damage occurs from rind breakdown, causing rot in the damaged area.

Rind breakdown is not an issue every year, and seems to be more prevalent in certain orchards, perhaps because of low temperatures or the velocity of wind-driven rain. The disorder may be prevented with one or two applications of oil or an anti-transpirant such as *CloudCover*™ or *Vapor-Gard*™ after color change and before rains begin. Research has shown that treatment can reduce incidence of the disorder by more than 90%.

- Rot

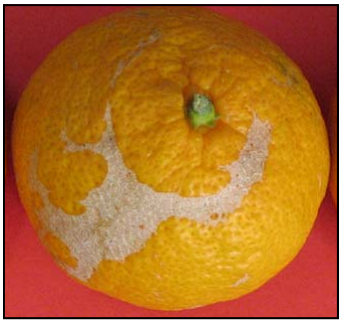
- Dirt or foreign material

Insect-related Defects

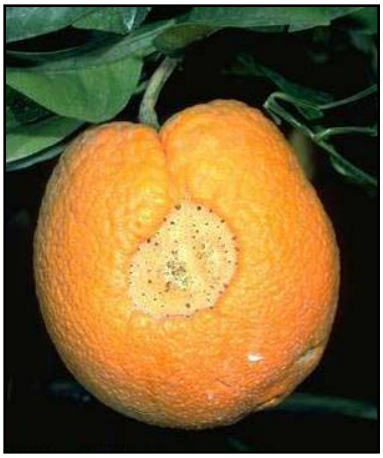
- Honeydew from Citricola scale and sooty mold growth

- CA red scale (or other insects) present on fruit

- Citrus thrips damage



- Katydid damage



Best Management Practices for High Quality Fruit

The consequences of poor cultural practices can seriously impact fruit quality. Overirrigation and/or excess nitrogen can lead to insipid fruit, with poor flavor development, rind puffiness, and a shorter shelf life. Excess water or nutrients may delay maturity of fruits, which can mean an economic loss to the producer.

Reduce Water Stress

Water stress caused by irregular or inadequate irrigation may cause dry sections in the fruit and can lead to bitter or sour flavored fruits. Insufficient summer irrigation water also increases sunburn incidence, reducing marketable yields.

For high quality fruit, irrigations should be planned to meet plant needs. Tensiometers or matrix blocks are good tools to measure soil moisture and schedule irrigations according to plant needs. Irrigation should occur as soil in the trees root zone dries, not after it is completely dry. Constantly wet soil is not good for citrus either, as it increases susceptibility to root disease.

Proper irrigation can mitigate some of the stresses that citrus encounter in the foothills. These stresses can include high summer heat or frost and freezing events in winter. Plan irrigations ***before*** such stress occurs.

Winter Irrigation

Given the high rainfall in the foothills, it does not seem like winter drought stress should be an issue, but it can be. Often there are periods of two or three weeks without rainfall in January or February. Citrus do not go completely dormant, so this winter water stress can affect bloom and subsequent fruit set. Check soil moisture when intervals between winter rains are long and weather is relatively warm. Irrigate if soil is drying in the upper 12" of the root zone.

Nutrient Management

Good nutrient management is critical to fruit quality. Rind puffiness can be related to excess or late nitrogen applications. Nitrogen demand in the tree is highest between spring growth flushes and early June, so most applications should be in that period. The last nitrogen applications on mandarins should be no later than early August to prevent impacts on fruit quality and cold hardiness.

A mature mandarin tree needs between ½ and 1 lb actual N per year. Trees that are pruned low for ease of harvesting need less than very large, old trees. Nitrogen applications should be planned based on the results of tissue testing each fall (August-October). The range for N should be between 2.2 and 2.4.

Pruning

Pruning is an important cultural practice that can impact quality. Prune out overly vigorous branches that shoot up from the crown. These branches, called watersprouts, are slow to fruit, and produce "uglies": large, rough, misshapen fruit with thick skins. Prune to keep tree canopies relatively open so fruit are exposed to sunlight.

Prevent Insect Damage

Thrips cause cosmetic damage to the stem end of mandarins, reducing its salability. If orchards are mowed at bloom, thrips may move from orchard weeds or cover crops into the trees. To avoid damage, mow cover crops or weeds before citrus bloom.

Thrips are often more of a problem in orchards that are sprayed frequently, especially if organophosphate (OP) pesticides such as Lorsban are used. OPs reduce populations of natural enemies and Lorsban has been shown to stimulate citrus thrips reproduction. Instead use abamectin or spinosad, which are less harmful to natural enemies.

Citricola scale can cause unsightly discoloration of mandarins. The insects produce large quantities of honey dew, a sugary substance which drips down onto fruit. Sooty mold then grows on the honeydew, causing dark, sticky stains on fruit. Moderate *Citricola* infestations can be controlled by pruning. Prune to reduce dense canopies and maintain light and air movement in the interior canopy. A tree with a well pruned canopy should have dappled sunlight under the tree at midday.

Scale is often "farmed" by ants, who move it around and protect it from predators. Controlling ants with baits or Tanglefoot® will help reduce scale populations.

Scales and thrips have many natural enemies, so avoid broad spectrum pesticides to preserve those helpful insects. If a specific problem requires spraying, time sprays to minimize impacts on natural enemies.

Excess use of nitrogen produces succulent, tender growth, which is attractive to many insects. Planning a fertilizer program in accordance with the trees' needs will reduce insect problems.

Good Harvesting Practices

Fruit needs to reach the consumer in good condition in order to be appreciated for its quality. Harvesting, sorting, and packing practices play an important role. First, harvest dry fruit, if possible. If not, it must be dried. Wet fruit is more

susceptible to mechanical damage and fungal infection. Never pick fruit off or near the ground as it is more likely to be contaminated with soil or disease spores. If there are diseased fruit on a tree to be harvested, cut them and dispose of them before harvesting the rest of the tree.

Avoid mechanical damage to fruit by clipping stems as short as possible. Pickers should wear gloves or keep fingernails clipped short to prevent accidental damage to rind. When transferring fruit, pour gently from picking bag into container.

Good sanitary practices will assure good food safety. Clean hands are critical. Workers should clean hands before picking or packing, and after touching infected fruit or using bathroom facilities.

Sorting Practices

Do not expect to sell all your fruit, always sort for quality! Even if you are not sizing fruit, sticking to a similar size range in each bag will make them more appealing to consumers.

Cull out any fruit with rind defects, as they will shorten shelf life. Cull piles should be sited well away from trees or the packing area to prevent contamination of sound fruit. Handle any diseased fruit carefully so spores do not spread. Clean hands and equipment after handling any infected fruit to prevent spread of disease.

Packing Practices

To maintain fruit quality, avoid packing too much fruit ahead of time. Do not squeeze fruit into the box. Workers packing fruit should wear gloves or have very short fingernails to avoid damaging fruit rinds. Bagged fruit should not be stacked more than 3 or 4 bags high.