

Lemon

Recommendations for Maintaining Postharvest Quality

Mary Lu Arpaia¹ and Adel A. Kader²

¹*Department of Botany and Plant Sciences, University of California, Riverside*

²*Department of Plant Sciences, University of California, Davis*



Produce Facts

MATURITY INDICES

A minimum juice content by volume of 28 or 30% depending on grade; color lemons picked at the dark-green stage have the longest postharvest life while those picked fully-yellow must be marketed more rapidly.

QUALITY INDICES

- Yellow color intensity and uniformity
- Size
- Shape
- Smoothness
- Firmness
- Freedom from decay
- Freedom from defects including freezing damage, drying, mechanical damage, rind stains, red blotch, shriveling, and discoloration.

OPTIMUM TEMPERATURE

12-14°C (54-57°F) depending on cultivar, maturity-ripeness stage at harvest, production area, and duration of storage and transport (can be up to 6 months).

OPTIMUM RELATIVE HUMIDITY

90-95%

RATES OF RESPIRATION

Temperature	10°C (50°F)	15°C (59°F)	20°C (68°F)
ml CO ₂ /kg·hr	5-6	7-12	10-14

To calculate heat production multiply ml CO₂/kg·hr by 440 to get BTU/ton/day or by 122 to get kcal/metric ton/day.

RATES OF ETHYLENE PRODUCTION

<0.1 µl/kg·hr at 20°C (68°F)

RESPONSES TO ETHYLENE

If degreening is desired, lemons can be treated with 1-10 ppm ethylene for 1-3 days at 20 to 25°C (68-77°F), but this exposure may accelerate deterioration rate and decay incidence.



RESPONSES TO CONTROLLED ATMOSPHERES (CA)

CA of 5-10% O₂ and 0-10% CO₂ can delay senescence including loss of green color of lemons. Fungistatic CO₂ levels (10-15%) are not used because they may induce off-flavors due to accumulation of fermentative volatiles, especially if O₂ levels are below 5%. Removal of ethylene from lemon storage facilities can reduce rate of senescence and decay incidence.

PHYSICAL DISORDERS

Oil spotting (Oleocellosis). Breaking of oil cells due to physical stress on turgid fruits causes release of the oil that damages surrounding tissues. Avoiding harvesting lemons when they are very turgid and careful handling reduce severity of this disorder.

PHYSIOLOGICAL DISORDERS

Chilling injury. Symptoms include pitting, membranous staining, and red blotch. Severity depends upon cultivar, production area, harvest time, maturity-ripeness stage at harvest, and time-temperature of postharvest handling operations. Moderate to severe chilling injury is usually followed by decay.

PATHOLOGICAL DISORDERS

Green mold. Caused by *Penicillium digitatum* which penetrates the fruit rind through wounds. Symptoms begin as water-soaked area at the fruit surface followed by growth of colorless mycelium, then sporulation (green color).

Blue Mold. Caused by *Penicillium italicum* which can penetrate the uninjured peel and can spread from one lemon to adjacent lemons. Symptoms are similar to green mold except that the spores are blue.

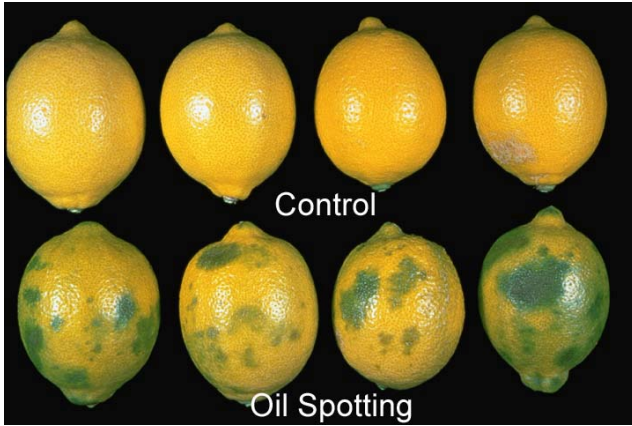
Alternaria rot. Caused by *Alternaria citri* which enters the lemons through their buttons. Preharvest treatment with gibberellic acid or postharvest treatment with 2, 4-D delay senescence of the buttons and subsequent decay by *Alternaria*.

CONTROL STRATEGIES

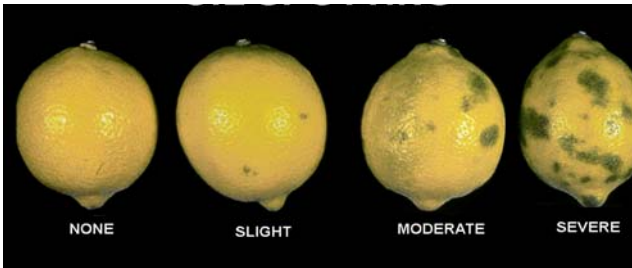
- Careful handling during harvesting and handling to minimize cuts, scratches, and bruises.
- Treatment with postharvest fungicides and/or biological agents.
- Prompt cooling to the proper temperature range.
- Maintaining optimum ranges of temperature and relative humidity and exclusion of ethylene during transport and storage.
- Effective sanitation throughout the handling system.

POSTHARVEST PHOTO GUIDE

DISORDERS



OIL SPOTTING



OIL SPOTTING



SCLEROTINIA ROT



It is the policy of the University of California not to engage in discrimination against or harassment of any person, employed by or seeking employment with the University, or in any of its programs or activities, on the basis of race, color, national origin, religion, sex, gender, gender expression, gender identity, pregnancy, physical or mental disability, medical condition (cancer-related or genetic characteristics), genetic information (including family medical history), ancestry, marital status, age, sexual orientation, citizenship, or service in the uniformed services, as well as state military and naval service. This policy is intended to be consistent with the provisions of applicable state and federal laws and University policies. University policy also prohibits retaliation against any employee or person seeking employment for bringing a complaint of discrimination or harassment pursuant to this policy. This policy also prohibits retaliation against a person who assists someone with a complaint of discrimination or harassment, or participants in any manner in an investigation or resolution of a complaint of discrimination or harassment. Retaliation includes threats, intimidation, reprisals, and/or adverse

In addition, it is the policy of the University of California to undertake affirmative action, consistent with its obligations as a Federal Contractor, for minorities and women, for persons with disabilities, and for covered veterans. The University commits itself to apply every good faith effort to achieve prompt and full utilization of minorities and women in all segments of its workforce where deficiencies exist. These efforts conform to all current legal and regulatory requirements, and are consistent with University standards of quality and excellence. In conformance with Federal regulations, written affirmative action plans shall be prepared and maintained by each campus of the University of California, by the Lawrence Berkeley National Laboratory, by the Office of the President, and by the Division of Agriculture and Natural Resources. Such plans shall be reviewed and approved by the Office of the President and the Office of the General Counsel before they are officially promulgated. Inquiries regarding the University's equal employment opportunity policies may be directed to the Affirmative Action Contact, University of California, Agriculture and Natural Resources, 2801 Second Street, Davis, CA 95618 (530) 750-1318.