



Growing fruit quality, strength and condition from farm to market

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THANKS,

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FRUIT QUALITY, STRENGTH AND CONDITION START IN THE FARM

- The challenge.
 - Climate change: heat waves, draught,... excessive rain,... most varieties are not resilient enough, resulting in light crops and inconsistent quality, strength and fruit condition.
 - Long term to change to more resilient varieties.
- Tools:
 - Plant nutrition. Ca/B (cell wall), P (cell membrane – phospholipids),...
 - Plant stress management and biostimulation.
 - Plant growth regulators (PGRs): mainly GA and auxins,..., salicylic acid, brassinosteroids,...
 - Biostimulants: seaweed extracts, ...
 - Anti-stress compounds (osmoregulators): glycine betaine, proline,...
 - Bioactives (elicitors) that enhance/activate the plant defense system: plant extracts, volatiles, peptides,...
 - Microorganisms.
 - Canopy management for optimum crop balance to manage stress and light exposure for consistent fruit quality and strength.

GENERAL CALCIUM / BORON SPRAYS

- General Calcium / Boron sprays.
- Calcium is the most important nutrient for cell wall strength and general citrus fruit condition.
- Calcium is the most difficult nutrient to get into citrus fruits.
- Boron should be always applied with calcium.
- Narrow timing for optimum foliar calcium uptake.
- Most of the calcium uptake takes place at cell division: between early fruit set and the end of the natural fruit drop.
- Fertigation of calcium is not enough, even high applications.
- Foliar applications of Calcium / Boron (2 to 4) during cell division and early cell expansion are critical (high density stomata and less wax) for most citrus.
- **Calcium / Boron applications at initial colour break to harvest for postharvest strength and condition.**
 - **Varieties: Cara Cara, Washington, Leng,... Daisy, Nadorcott,.... Particularly late harvest or storage.**

T1. GA / AUXINS, CALCIUM / BORON,...

Timing 1. Petal fall to the end of natural fruit drop (early December).

- 1 or 2 sprays: GA/auxins + Ca/B + K + Zn + Mn +....
- Normally, 1 foliar spray at petal fall and sometimes 1 spray for fruit sizing close to the end of natural fruit drop.
- Calcium nitrate will be effective for most varieties at cell division.
- Sensitive varieties and weather conditions prone to albedo breakdown, splitting and/or soft fruit, the following could be added to the standard foliar nutrient spray for better results:
 - Calformate: 200 g/100L (or other calcium specialty products) plus
 - OsmoShield: 100 g/100L.
- This is the most critical timing for calcium sprays to build up calcium into the fruits for strong cell walls.

T2. EARLY SUMMER GA SPRAYS AND CALCIUM / BORON

Timing 2. Early summer GA sprays. From mid December to late January/mid February (Southern Australia/WA).

- **1 or 2 sprays. GA 20ppm + Ca/B + K + Zn + Mn.**
- If hot weather conditions and more prone varieties and blocks, the following could be added:
 - CalFormate: 200 g/100L (or other calcium specialty products) plus OsmoShield: 100 g/100L.
- This is the main spray/s to reduce albedo breakdown and to build up fruit strength at harvest.
- December spray for varieties that could have difficulties to develop fruit colour: Late navels, Afourer, Tango,... or early maturity: M7, Navelina,....
- Two (2) applications for varieties sensitive to albedo breakdown: Navelina, Washington, Cara Cara, Daisy and its irradiated varieties,...
- The 2nd application could be delayed from late January until mid to late February for late harvest fruit only, then, reducing the need of GA at colour break.

T3. STOP DROP, CALCIUM FORMATE (CFB) AND OSMOSHIELD (GB)

Timing 3. From initial colour break (Stop Drop spray) to harvest.

- **New research: University Miguel Hernandez.** Preharvest applications with postharvest effects extending shelf life and improving strength and fruit condition.
 - **Calformate: 200 to 250 g/100L.**
 - **OsmoShield: 100 to 150 g/100L.**
- Calcium Formate has a high uptake for late season applications and does not delay fruit colour.
- 1 to 2 applications depending on varieties and seasonal conditions.
- First application at initial colour break with Stop Drop.
- Synergistic effect between calcium/boron and glycine betaine (anti-stress):
 - Reduction of weight losses.
 - Less acid drop that results in better fruit condition and less decay.
 - Lower MDA means less lipid peroxidation and longer shelf life.
 - Lower EL means stronger membrane integrity.
 - Overall reduced risk of chilling injury.

T3. STOP DROP, CALCIUM FORMATE (CFB) AND OSMOSHIELD (GB)

Timing 3. From initial colour break (Stop Drop spray) to harvest.

- Other nutrients: copper, silica, molybdenum,... also have a positive effect strengthening the rind and adding synergies through different modes of action.
- Sergomil L60: Copper formulated with mono gluconic and galacturonic acid.
 - Assimilation, translocation and availability of copper.
 - Copper coenzymes participate in many enzyme reactions .
 - Copper strengthens the cell wall (copper-cellulose complex).
 - Galacturonic acid elicitor of self-defence mechanisms: synthesis of phytoalexins.
 - **Sergomil L60: 200 - 250 g/100L.**

POSTHARVEST APPLICATIONS TO REDUCE CHILLING INJURY

- **Drencher.**
 - Fortifying nutrient solutions: calcium and phosphorus salts,... or
 - Special coatings.

- **Hot water brushing treatment HWBT. (EF) Even Flow.**

Hot water brushing (10-30 s at 55-64 °C; Israeli patent 116965)

- Oranges: 50 to 55°C and 30 - 15 seconds brushing.
- Mandarins: 40 to 45°C and 30 - 15 seconds brushing
- Production of heat shock proteins (HSPs):
 - To keep cell membrane integrity.
 - ROS scavenging.
 - Production of antioxidants.
- High temperatures (> 45°C) inactivate enzymes responsible for rind softness.
- Increase the concentration of polyamines that strengthens cell walls.
- Thiabendazole (1000 ppm).
 - Unknown mechanism that reduces chilling injury.
 - Increased effect due to hot temperature
- Special coatings.

POSTHARVEST APPLICATIONS TO REDUCE CHILLING INJURY

- **Wax.**
 - Special waxes: Carnauba, Long Life, CI Protect,... to minimise chilling injury.
 - Thiabendazole (5000 ppm), when registered for wax application.
 - Special coatings.