Oleocellosis Prediction Tools

by Steven Falivene NSW Agriculture, Dareton June, 2004 : V1.7 (based on information from Jim Hill, SARDI)

What Is Oleocellosis?

Oleocellosis (Oleo) is a significant threat when harvesting in winter. It can result in a complete repack of fruit with the grower bearing the cost. It is of significant concern because symptoms can show up a few days after the damage at harvest has occurred.

Oleocellosis is damage to the rind of citrus fruit caused by the release of oil from glands within the rind. Oil from a ruptured gland can spread over the surrounding rind surface, inducing rind damage symptoms. Rind damage on coloured fruit, initially shows as a slight reduction in gloss, followed by a collapse and discolouration of cells between the oil glands, leaving them visibly obvious (figure 1 & 2). Eventually the tissue below the oil glands collapses leaving a darkened, sunken area on the rind. The extent of damage depends upon how many oil glands are ruptured. The more oil glands that rupture result in a more pronounced symptom that will darken quickly. **On-tree oleo** does not produce a wide and pronounced symptom because only one oil gland may have ruptured (figure 3), whilst oleo caused by poor harvesting and handling practices produces a larger and more pronounced damage because more oil glands have ruptured and smeared over the surface of the fruit. If an oil gland ruptures below the surface of the rind this may result in similar surface tissue damage or it may appear as a pitted area on the rind due to the collapsed cells beneath it (figure 4).

Figure 1: Oleo damage in the early stages. Notice how the rind has collapsed leaving behind the raised remaining intact oil glands.

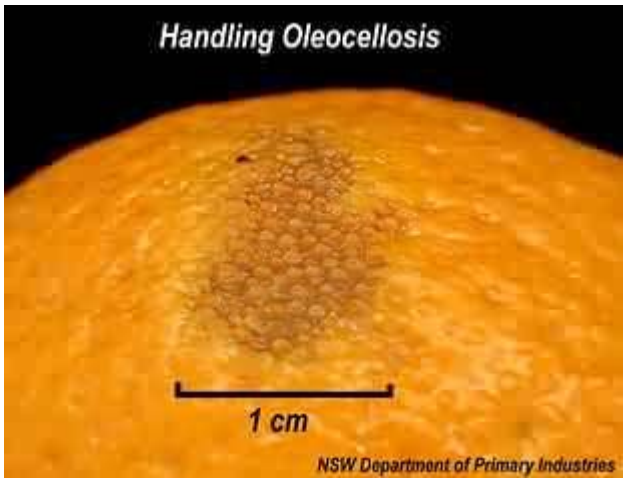

Figure 2: Oleo damage commencing to turn dark.

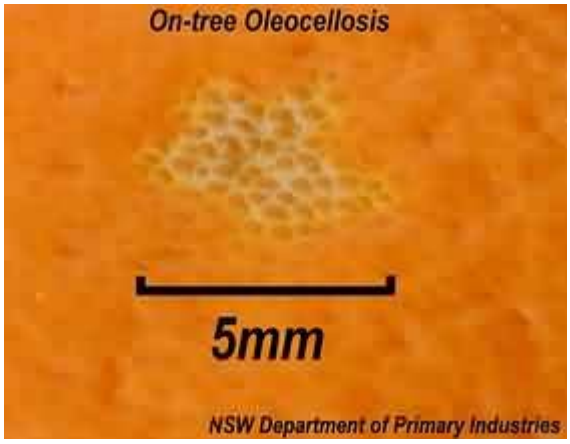

Figure 3: On-tree oleocellosis damage. Notice that the damage is restricted to a small area and the damaged rind is paler in colour.

Figure 4: A total collapse of the rind that could be the very late stages of oleo damage or another type of damage.

Early season fruit which is green or partially coloured is the most susceptible to Oleocellosis. Damaged rind will not continue to colour, leaving a green or pale area where the damage has occurred.

There is great variation in the occurrence of oleocellosis but it is highly correlated with rind turgidity.

How Does Injury Occur?
Damage can occur due to pressure or impacts that breaks the oil glands:

- on the tree by wind or equipment
- in the pickers' hand
- in the bin with rough surfaces or grit
- during transport
- in the packing line

On-tree oleo can also occur which produces a smaller and less pronounced damage than oleo damage caused by poor harvesting or handling procedures (figure 3). On-tree oleo is generally about 5mm to 8mm in diameter, whilst handling oleo damage is about 10mm plus in diameter (ie finger print, impact on the side of a bin etc). The on-tree oleo damage may not develop a deep dark colour. On-tree oleo is thought to be caused by unfavourable climatic conditions, or an insect piercing an oil gland or wind rub from a twig.

Oleocellosis Prediction Equipment
A simple method of predicting when to harvest navel oranges to prevent oleocellosis involves measuring the turgor pressure of the citrus rind and specific environmental conditions to determine the risk of oleocellosis damage occurring during harvest.

Jim Hill (SARDI) had developed inexpensive instruments to measure the rind turgor pressure of citrus and relevant environmental conditions. These instruments were sold as an "Oleocellosis Prediction Kit". These kits are no longer available, however commercially built equipment can purchased separately from suppliers listed below. The commercial equipment is expensive, but consider the cost to your returns if you get oleo damage! Also check with your local citrus industry organisation for they could provide a cheaper price from bulk buying. Please note that NSW Agriculture or ACG does not endorse any of the suppliers of equipment listed below, it is only a list of known suppliers for the readers convenience.

- **Rind Pressure Gauge**: A device to quickly apply up to a 5 kilogram pressure to a known area on the citrus rind. A piece of tissue is placed between the pressure probe and citrus rind. Pressure is applied and once a rupture of the oil cell is noted (by the wet appearance of the tissue), a reading is taken. A rind turgor pressure gauge (5kg) can be purchased from agricultural equipment or leading scientific instrument suppliers (E.E. Muirs ph 03 99310155, other suppliers could exist , please notify if you know of other suppliers). These cost about $310 however check with your local citrus industry organisation for they could provide a cheaper price from bulk buying.

- **Rind Temperature Gauge**: This is an electronic/digital thermometer with a narrow metallic measuring sensor (prong) that can be inserted into the fruit and they cost about $30. Electronic stores and some district agricultural stores (sometimes used for table grapes) sell these digital thermometers (Temperature Technologies : digital waterproof thermometer with stainless steel probe RT600 Ph :08 82311266).

- **Whirling Hygrometer**: The wet bulb temperature gauge is known as a "whirling hygrometer" because to take a measurement it is swung around so air will flow over the sensor. More expensive models can be purchased that are not swung around but a small electric fan blows air over sensor, or the sensor is electronic and does not require air movement. The basic whirling model costs from about $95 whilst the electronic model costs about $390. These can be purchased from : Prospectors Ph: 02 98387899 (www.prospectors.com.au), Sperscientific Ph 07 4773 9444 (www.sperscientific.com), PCWI Ph : 02 49543999 (www.pcwi.com.au), or Geodetic Supplies Ph 08 94094058 (www.geodetic.com.au) (other suppliers could exist , please notify if you know of other suppliers). A "home made" version can be built using a standard electronic/digital thermometer, an piece of wire, tube cloth wick and a empty film canister. Jim Hill constructed such a "home made" devices for his kit by fitting a small tubed wick type cloth over the end of the thermometer bulb. The wick was inserted into a film canister half filled with water and the device was held together by strong wire.

Using Oleocellosis Prediction Equipment

- **Rind Temperature Wet Bulb Test**: Select a fruit from the southern side of the tree close to the skirt of the tree. Insert the thermometer a couple of millimetres into the rind. Do not insert the temperature gauge through the rind and into the pulp. Take a wet bulb temperature reading using the "whirling hygrometer" (or any other wet bulb measuring device) on the southern side of the tree. Spinning the hygrometer for about 30 seconds is considered adequate. **If the difference between the rind temperature and wet bulb temperature is less than 3oC, this is considered as a high risk and picking should be avoided**. A temperature difference less than 3oC means that the fruit can not easily evaporate water from the rind and the rind remains turgid.

- **Rind Oil Release Pressure Test:** If the wet bulb temperature test passes, then continue with this, rind oil release pressure test. If rind oil release pressure test is carried out too early in the day during unfavourable climatic conditions (i.e. test 1 does not pass), rind oil release pressure test may provide a false reading. The false reading might be too high because the tree has not stabilised its water balance and falsely indicate that it is safe to pick. Take a 20 fruit sample from the orchard that has not been exposed to direct sunlight (i.e. fruit on the western/southern side or inside of the tree). Fruit exposed to direct sunlight generally have higher readings. A 20 fruit sample is considered as minimum, more fruit sampled will provide a more reliable result. Attach the 8mm tip to the pressure gauge. Place a piece of tissue paper (toilet paper, facial tissue) on the fruit surface. Slowly press the penetrometer on the fruit rind with the tissue paper underneath. Stop pressing as soon as you see the tissue paper stain with wetness (rind oil release). Read the pressure on the gauge in kilograms and enter you result on the field monitoring sheet (see below for link to data sheet). **Rind pressure readings that falls below 3 kilograms is considered as having a high susceptibility to oleo damage**. If one out of the 20 fruit sampled had a reading below 3kg, then about 5% (1/20) of the fruit may be susceptible to damage. If five out of the 20 fruit sampled had a reading below 3kg, then about 25% (1/20) of the fruit may be susceptible to damage. The decision to pick is your own calculated risk, but as a guide if more than two fruit from a 20 sample (10%) provide a negative result (below 3kg), then picking should be avoided.

For an evaluation of the method to be effective the percent oleocellosis damage must be traceable from the packout records and related to the field monitoring record sheet. Field tests reveal that the above method is useful in reducing the risk of oleocellosis. Keeping records can isolate areas of high risk and manage the harvesting of the fruit accordingly.

Care must always be taken when harvesting citrus even if the oleocellosis test equipment gives a positive reading. **Damage can still occur if the oleocellosis test kit gives a positive reading through rough picking and handling practices**. Citrus fruit can also develop oleocellosis damage from other factors (environmental, cultural, and varietal) at any period. **The test kit only provides a guide to high risk periods**. Use of good harvest and handling practices is still the most important strategy for reducing oleocellosis damage.

Further reading:
Oleocellosis Prediction Equipment
Oleocellosis Prediction Data Sheet
Oleocellosis & Oleo Audit