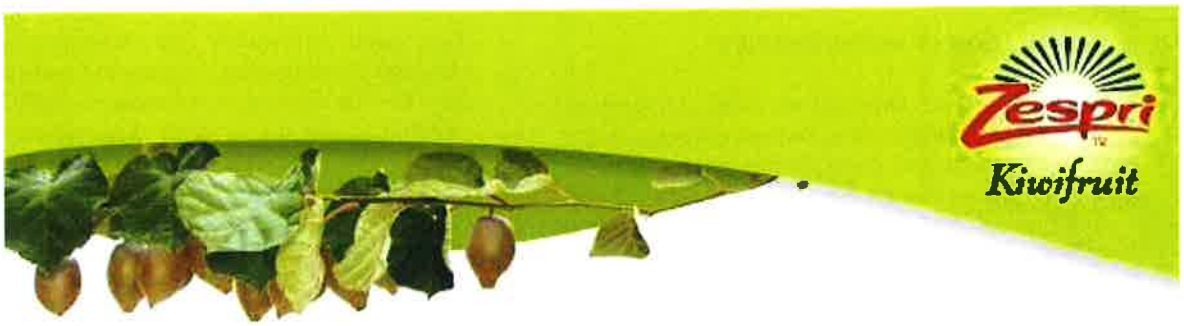

KiwiTech Bulletin No. 48
Brix Testing Using a Refractometer

March 2008

Kiwifruit contain many compounds which are soluble in water, for example, sugars, acids, vitamin C, amino acids, and some pectins. These soluble compounds form the 'soluble solids' content of the fruit. In kiwifruit, sugar forms the main component of the total soluble solids content (SSC). Since the amount of sugar in fruit increases as the fruit matures and ripens, the soluble solids content of the fruit is an indicator of GREEN fruit maturity and its stage of ripeness. When the fruit is ripe, the soluble solids content determines the perceived sweetness of the fruit when it is consumed. Therefore, soluble solids content of both ripe GREEN and GOLD kiwifruit is an important quality characteristic (refer to KiwiTech Bulletin 45 for an explanation of the relationship between kiwifruit taste, dry matter and brix).

Refractometers use light refraction through a prism to measure the sugar content of liquids, the greater the concentration of sugar, the greater the refraction through the prism. In use, a juice sample is sandwiched between a measuring prism and a small cover plate. Light travelling through the sample and prism causes a shadow line to be formed. It is at the point that this shadow line crosses the scale that a reading is taken.

Refractometers give readings in % sucrose or degrees Brix (°B). They have been calibrated assuming that the only compound in the solution being tested is sucrose, and this approach gives a good estimate of %SSC in kiwifruit.

By using a refractometer to test the soluble solids of a representative fruit sample, orchardists can assess the maturity of their GREEN kiwifruit crop, and thus ensure their fruit is harvested at the optimum maturity for good storage performance, shelf life and meet minimum maturity standards. In the markets, refractometers can be used in quality assessment to determine the final sugar content of ripe fruit.

Figure 1. Examples of hand-held (left) and digital (right) refractometers, both being commercially available through laboratory supply companies.

Types of refractometer

When choosing a refractometer it is important that:

- The scale is easy to read and is of an appropriate scale (0 – 20%).
- There is good contrast between the light and dark portions of the field of view and that the demarcation line is fine and distinct.
- The instrument can be easily and accurately calibrated, but does not go out of adjustment easily.
- The instrument is robust.

Calibration of refractometer

To calibrate the refractometer place a few drops of, ideally distilled water, though clean tap water is okay, onto the refractometer prism surface. Close the prism cover, ensuring that no air bubbles are trapped in the water film, and then point the refractometer toward a light source. If necessary, focus the eyepiece. A circular field is seen through the eyepiece with a vertical scale to one side marked in divisions. With liquid on the prism the field will be divided into light and dark portions (Figure 2).

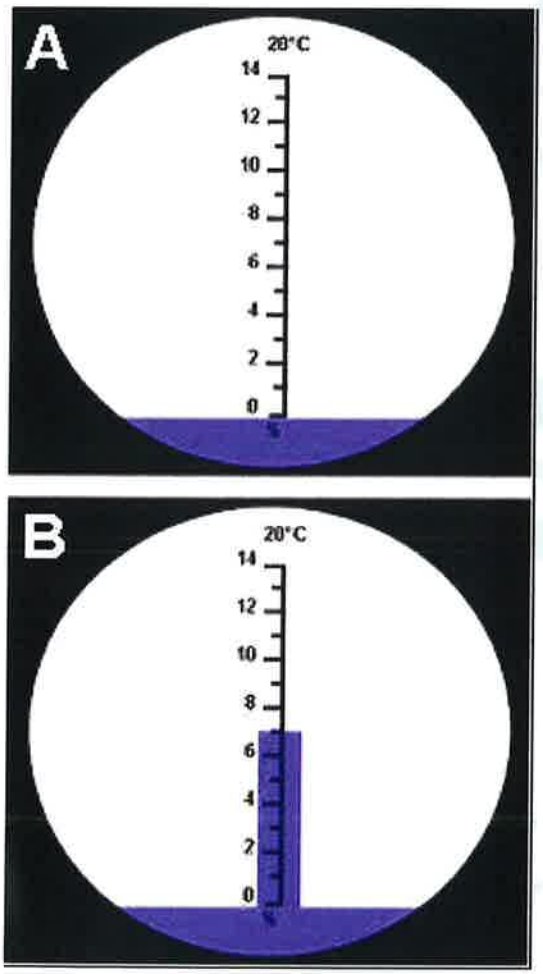

Figure 2. The position at which the demarcation line between light and dark regions crosses the vertical scale gives the soluble solids reading. Distilled water is used for refractometer calibration and should give a reading of zero (top), the bottom view is indicating a sample reading of 7.0 °Brix.

The point at which the demarcation line between these portions crosses the vertical scale give the °B reading or estimate of %SSC. With distilled or clean tap water this reading should be 0%. The line of demarcation can be adjusted on the vertical scale by screws above or below the prism box.

Having zeroed the refractometer with water, it is also advisable to check its accuracy at higher °B, using freshly made sucrose solutions of known concentration (e.g. 6% sucrose solution is made from adding 6g of sucrose to 94 ml of water). Sucrose solutions of known concentrations are also readily available from pharmacies.

Refractometer readings of °B alter slightly with temperature. Refractometers are calibrated to be used at 20°C and so both the instrument and the fruit should ideally be at this temperature. Temperature variations of 2-3°C either side of 20°C have little significant effect on °B readings.

If measurements have to be taken in hotter or colder conditions then the refractometer can be recalibrated using water and sucrose solutions at the ambient temperatures.

Selection of fruit for sampling

While a sample of 10 fruit will provide a reasonable estimate of the average, 30 fruit as used in Main-Pack maturity clearance samples (refer to the ZESPRI Quality Manual), provides greater accuracy and can be used to look for trends.

▪ Sampling from the vine

Maturity monitoring requires the collection of a random, representative fruit sample from across the orchard area of interest.

Fruit should be sampled from random vines selected following a grid pattern across the orchard area (refer to KiwiTech Bulletin 44: Orchard Crop Estimation).

Fruit samples should be collected according to the nine standard industry sampling positions (Figure 3), and be collected 'blind' (by harvesting fruit from behind your head while walking forward), to avoid accidentally biasing the results. Only export grade fruit should be used.

It is recommended you start in the TB position of the vine and sample individual fruit sequentially through the nine sampling positions (Figure 3) as this is standard practice with independent lab collections. The sampling sequence is as follows: TB, MB, EB, TM, MM, EM, TE, ME, EE.

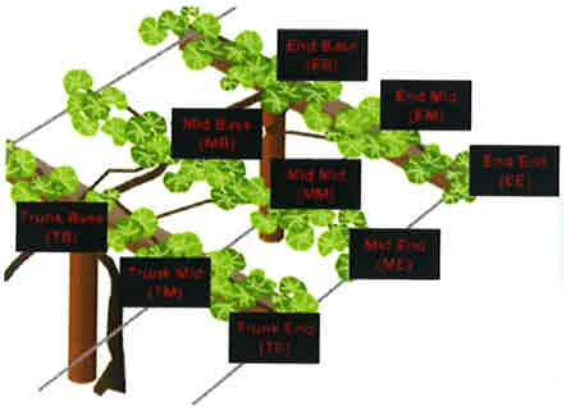

Figure 3. The nine areas within vines that the fruit sample should be sequentially collected from. A single fruit should be sampled from each of 10-30 vines across the orchard area.

- **Sampling from bins/pallets**

From the bins or pallets that make up the population of fruit that is to be sampled (i.e. from an individual orchard, or from an individual maturity area), take a sample of 30-90 fruit randomly from across a minimum of 20% of the bins/pallets. Do not sample over-soft fruit.

If the fruit sample is coming out of cool-storage, allow the fruit to warm to ambient temperatures before testing.

- **Sampling in-market**

Collect a representative sample consisting of at least 10 fruit from the same line. (e.g. same KPIN, pack-type, variety, and growing method). Do not sample over-ripe, damaged or very firm fruit. Fruit should be of eating firmness (1.0 – 0.7 KgF) and easily cut with a knife.

If fruit are tested too firm, the resulting measurement will not be representative of full-term brix.

Again, if the fruit sample is coming out of cool-storage, allow the fruit to warm to ambient temperatures before testing.

Testing procedure

Ensure fruit is dry as any moisture mixing with the juice will lower the readings.

Cut the stem and blossom ends at a distance of 15mm in from each end of the kiwifruit for MainPack GREEN (for KiwiStart and Modified Brix, measurement is from the blossom end only) (Figure 4).

For GOLD kiwifruit, 15mm slices are taken from both the stem and beak ends of the fruit.

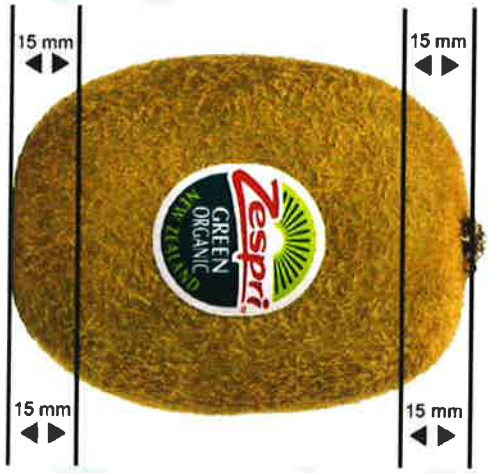

Figure 4. Kiwifruit sample preparation for Brix testing: 15mm slices are cut from the top (stem end) and the bottom (blossom end) of the fruit.

For each fruit slice (Blossom end is always tested, both stem and blossom ends are tested for MainPack maturity clearance and in-market testing):

- Squeeze an equal number of drops from each fruit slice on to the refractometer prism surface (Figure 5). Enough fruit juice should be placed on the prism surface so that a thin film of juice covers the prism, with no air bubbles, when the prism cover is closed.

- Care must be taken that no seeds, hairs or other coarse material are trapped in the prism box, to avoid pitting of the prism surface.

Figure 5. Juice is squeezed from either the stem or blossom end fruit slices onto the refractometer prism surface and the prism cover closed.

- Read the percentage soluble solids promptly and record (Figure 6). Although the refractometer should be read with the daylight plate facing upwards, there are times when a cleaner reading will be obtained by inverting the refractometer, and holding the prism door shut, e.g. when fruit is immature and starch levels are high. This allows the starch grains to settle away from the prism surface.

Figure 6. The Brix measurement is seen through the eye piece once the refractometer is pointed towards a light source. The eyepiece may need to be focussed to suit the operator.

- The prism surface should be cleaned with water and dried with a soft tissue between each reading (Figure 7).

- Repeat procedure for all fruit in sample.

Figure 7. The refractometer is cleaned of fruit juice using water and dried with a soft tissue between each measurement.

Calculation of Brix for fruit maturity

- Calculate the average soluble solids content for all fruit assessed in the sample.

- This gives the average soluble solids content of the sample, which is an indicator of GREEN kiwifruit maturity at the time of sampling.

- GREEN maturity levels so determined can be compared to harvest clearance standards or storage guidelines, as documented in the ZESPRI Quality Manual. This is available online at:

  www.zespricanopy.com

(Suppliers / Quality manual / Pre-harvest management)

Calculation of Brix for in-market testing

- Calculate the average soluble solids content for all fruit assessed in the sample.

- This gives the average soluble solids content of the sample, which is an indicator of the 'sweetness' level of ripe GREEN or GOLD kiwifruit in the markets.

- The soluble solids content of ripe GREEN and GOLD fruit in the markets gives an indication of how good the fruit will taste when eaten (refer to KiwiTech Bulletin 45: Taste, Dry Matter and Brix). The present "Y" Taste bands aim to deliver an average in-market brix greater than 14.2 and 14.8 for ripe GREEN and GOLD fruit respectively.

References

- Fruit Maturity Testing: Refractometer Use. AgLink Bulletin 212. MAF Information Services, 1986.
- KiwiTech Bulletin 33: Maturity Areas. www.zespricanopy.com
- KiwiTech Bulletin 44: Orchard Crop Estimation. www.zespricanopy.com
- KiwiTech Bulletin 45: Taste, Dry matter and Brix. www.zespricanopy.com

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