



Department of
Primary Industries and
Regional Development



ANABBP 01[®]

apple maturity testing

A step-by-step guide

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Sweet &
Juicy

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ANABP 01[®] maturity sampling



Apple maturity testing should be undertaken prior to harvest to ensure fruit picked is at optimum maturity for the intended purpose; long, medium or short-term storage or immediate consumption.

Maturity testing includes recording fruit size measurements, the testing of apple firmness using a penetrometer, measuring the percentage of total soluble solids in the juice using a refractometer and a starch-iodine test which indicates the distribution of starch and its conversion into sugars. Maturity testing is not limited to these parameters but BRAVOTM minimum standards have been set for firmness and total soluble solids to ensure consistent eating quality apples for all consumers to enjoy. This testing in the lead up to harvest will determine the best picking maturity and indicate the potential storage ability of fruit to assist with developing a marketing strategy for all ANABP 01[®] fruit.



Equipment required

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To ensure accurate, uncompromised measurements, it is necessary that maturity testing equipment is maintained in good working order and is regularly calibrated. A clean, well-lit dedicated bench space is also required.

The following is a list of required tools. If you do not already have them, they can be purchased from your local rural resellers;

- Digital pocket refractometer (scale 0–53%) ATAGO or hand-held refractometer
- Distilled water, or water that has been boiled then allowed to reach room temperature
- Penetrometer electronic model or mechanical ideally mounted on a drill press with an 11mm tip for apples
- Starch iodine solution — this is prepared by dissolving 15g of potassium iodine in 1L of distilled water, then 5g of iodine crystals are dissolved in the potassium iodine solution
- continuously stirred until all crystals are dissolved
- Starch pattern index (SPI) charts
- Knife
- Potato peeler
- Cutting board
- Garlic press to extract juice for Brix testing
- Vernier calipers
- Scales with 1g graduations
- Personal protective equipment — see appendix for details
- Flat dish for dipping apple halves
- Paper towels

Pre-harvest sample — the ideal sample size should be 10 randomly selected fruit from an orchard block of the same tree age and rootstock. Make sure the fruit sampled are representative of the fruit intended to be harvested pending the results of the maturity test. This sampling may need to be repeated every few days until the minimum maturity standards and optimum quality is reached.

Harvest sample — the sample needed to represent the harvest line is much larger to provide an accurate assessment of maturity at the time of picking. The sample must be representative of the whole consignment and include apples from each bin. This sample will determine the storage potential of the fruit and must meet the BRAVO™ quality standards.



Sample of apples

Method

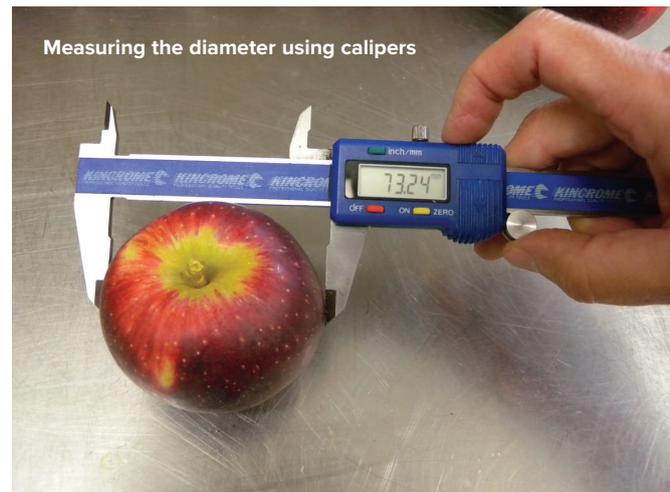
Step 1: Collect a sample

- a Collect a sample of 10 apples from the block. This could be a random sample from throughout the tree if a strip pick is planned or a targeted sample based on best colour fruit intended to be harvested if more than one pick is intended.
- b Lay out the 10 apples on bench and keep this order throughout the testing.

Step 2: Measure the diameter and weight

Fruit size and weight are useful measurements that when used in conjunction with other parameters, can help pre-empt packout sizes and provide data for yield of the block, district and seasonal comparisons.

- a Measure and record the diameter (width) of each fruit at its widest point using Vernier calipers.
- b Weigh each individual apple and record weight to the nearest gram.



Measuring the diameter using calipers



Measuring the weight of the apple

Step 3: Measure fruit pressure (flesh firmness)

Flesh firmness is measured using a penetrometer. Flesh firmness is expressed as the number of kilograms force (kgf) needed to push a metal probe of specific diameter a known distance into the flesh of the fruit. The higher the number registered the firmer the fruit is considered. Low numbers indicate that fruit may be soft or have poor texture. An 11mm penetrometer tip is used for assessment of apples. The accuracy of these results are reliant on the consistency of the operator and the equipment used.

- a Using a potato peeler or knife, remove a small section of skin from both sides of the apple. Preferably do one reading on the coloured side and one on the uncoloured side.
- b Using a Penetrometer with an 11mm tip, push into the fruit as far as the indicator line (1cm) to identify Fruit Pressure and record the kgf result.
- c Re-zero the penetrometer, and repeat the procedure for the other side of the fruit.
- d Clean the penetrometer with fresh water daily after use and avoid juice or water entering the plunger barrel.



Step 4: Measure the Brix (TSS)

Soluble solids help determine fruit maturity and as sugars contribute to the nutritional and sensory qualities of fruit. Sugars (fructose, sucrose and glucose) form the main component of total soluble solids (TSS) in apples. The most economical method of determining soluble solids levels is by using a hand held or pocket refractometer.

This measures the refractive index of the juice and gives readings in either % Sucrose or % Brix.

Typical ranges of ANABP 01[®] are 12–13.5%TSS prior to harvest, to 13.5–16.0%TSS as fruit reaches maturity.

There are two types: Hand-held refractometers, which have a prism with a lid for holding the juice sample or digital refractometers, which have a well for holding the juice sample.

- a Prior to use, calibrate your refractometer to 0% using distilled water. The water should be at the same temperature as the juice sample for an accurate reading. Wipe the surface of the prism dry with a soft tissue.
- b With a small dish or directly onto the refractometer, collect the juice that drips out as you insert the penetrometer to measure the sugar (%TSS) of each apple.
- c Alternatively cut a small piece of apple and squeeze using the garlic press to extract juice.



Step 5: Measure the starch pattern index (SPI)

This measurement relies on the simple fact that starch will stain black in the presence of iodine and potassium iodide, but is only suitable for fruit assessed within 48 hours of harvest. The starch pattern and amount is observed when determining SPI, rather than the darkness or intensity of blue/black colour.

Conversely the clear yellow/white pattern indicates regions of nil or low starch levels, where starch conversion to simple sugars has occurred. Little starch staining (higher SPI) at harvest means shorter storage life. Insufficient hydrolysis may mean less than optimal eating and post storage quality, with lack of flavour, high and/or low sugar level.

- a Keeping the order of apples, cut each apple in half across the diameter. The apple halves can either be dipped into iodine solution or sprayed with iodine solution.
- b Place the top half of each apple into a container of 1–2cm deep iodine solution and leave for about two minutes.

Iodine warning

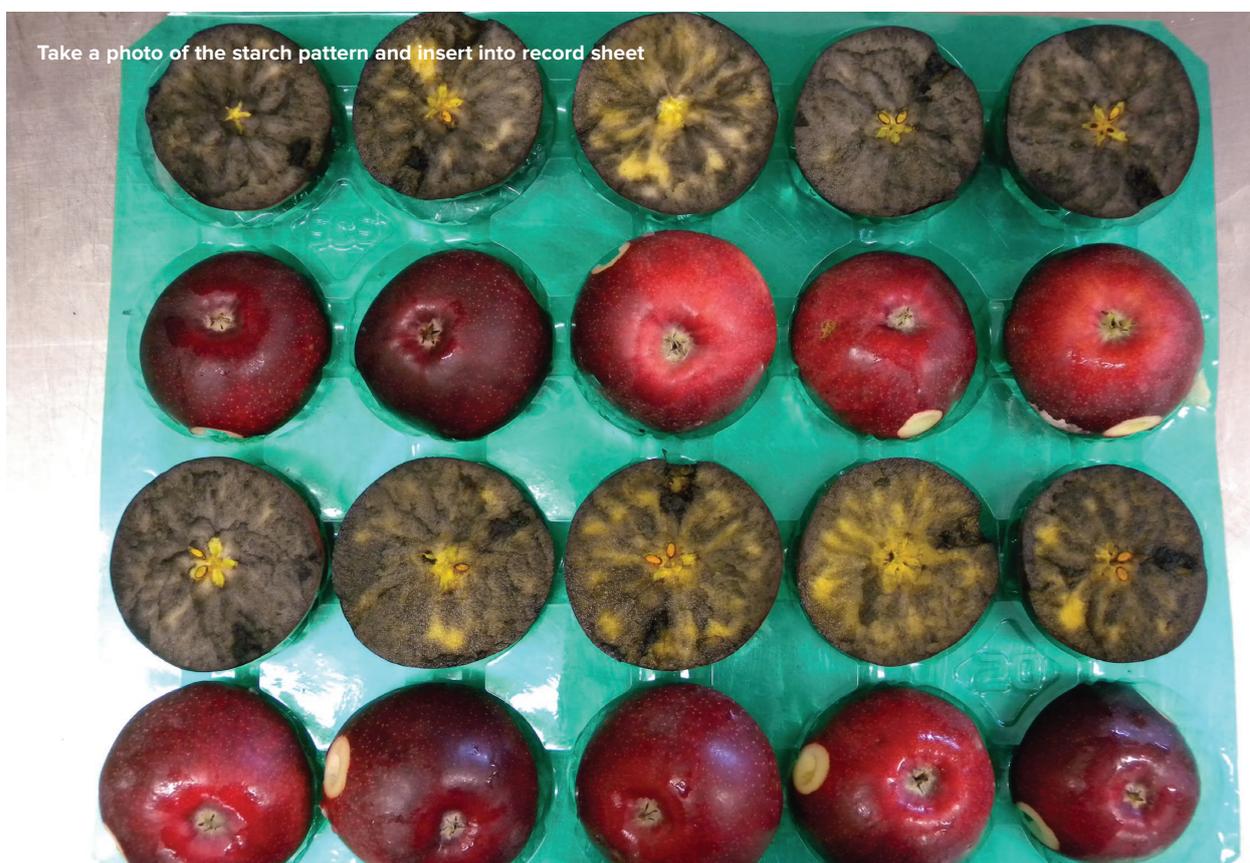
Iodine is toxic and will stain clothing permanently therefore care should be taken to avoid splashing, spills or getting iodine on skin. Iodine solution must be used in a well ventilated area, inhalation of fumes should be avoided. Spent solution must also be disposed of safely.

Iodine solution needs to be kept in an amber bottle in a cool dark place out of direct sunlight.





- c** Take each half out of Iodine Solution and place down on paper towel for a few seconds to remove excess liquid.
- d** Or using a spray bottle spray the apple half with iodine solution and allow starch to stain for at least 10 minutes.
- e** Place each apple half facing cut half up and re-match with its matching bottom half and leave to dry and starch to stain for at least 10 minutes (it won't matter if this is left for up to an hour).
- f** Photograph all 20 apple halves to be inserted into the maturity data sheet for reference.
- g** Give each apple a score using the 1–6 scale starch chart also known as the Washington State Scale. When matching the results with the chart, look for the area of staining rather than the intensity of the staining.



Starch pattern index charts

Starch conversion guide for maturity of BRAVO™ apples — radial pattern

	Starch degradation (1–6 scale)	Over-colour	Sugar % (° Brix)	Pressure (kg)
Immature — do not harvest	1 Definition: Full black stain with no clearing in cortex. 		12	>9kg
Long-term storage maturity	2–3 Definition: Clearing extends into the cortex (30%). Core partly clear. 		13	8–9kg
Optimum storage maturity	3–4 Definition: Clearing extends into cortex (50–60%). Core clear. 		14+	7–8kg
Short-term storage maturity	4–5 Definition: Clearing extends to 70% of cortex. Core clear. 		14+	7–8kg
Mature fruit — immediate sale	6 Definition: Almost entire cortex clear. 		14+	6–7kg

Apple maturity test record sheet

Orchard:	
Block:	Assessment date:
Variety: ANABP 01 [®]	Harvest date:

Fruit no.	Diameter (mm)	Weight (g)	Firmness 1 (kgf)	Firmness 2 (kgf)	Brix (TSS) (%)	Starch pattern index (1–6)	Comment on quality
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
Sum							
Average							
Optimum							

Attach photo of starch pattern here

Signed: Date: / /

A copy of this record sheet should be used each time a new apple maturity test is conducted.

Please refer to the latest version of the BRAVO™ quality specifications.

References

1. Little C. 1998. *A Manual of Procedures for Assessing Apple and Pear Maturities for Specific Storage Schedules*.
2. Little C. 2011 Reprinted. *Australian Apple and Pear Maturity Assessment Manual*.
3. Murphy White S, Stacy N, and Jacob S. 2019 *Apple Maturity testing: A step-by-step guide*. Pomewest.



Appendix — Iodine solution

**POISON S6
NOT TO BE TAKEN**

KEEP OUT OF REACH OF CHILDREN

Store away from direct light

Shake well before use

Contains: 15g/L Potassium Iodide, 5g/L Iodine

Shelf life = two months

Health hazards

Low to moderate toxicity — irritant. Chronic exposure may cause iodism, with symptoms of thyroid damage, rapid heartbeat, tremor, weight loss, diarrhoea, insomnia, eye irritation, bronchitis and skin rash. Use safe work practices to avoid eye or skin contact and vapour/mist inhalation.

Personal protective equipment

Wear splash-proof goggles and neoprene gloves. When using large quantities or where heavy contamination is likely, wear coveralls. Where an inhalation risk exists, wear an air-line respirator.

Emergency

Extinguish non-flammable.

First aid

Eye — Hold eyelids apart and flush continuously with water. Continue until advised to stop by the Poisons Information Centre, a doctor or for at least 15 minutes. Keep patient calm.

Inhalation — If over exposure occurs leave exposure area immediately. If irritation persist, seek medical attention.

Skin — Remove contaminated clothing and gently flush affected areas with water. Seek medical attention if irritation develops. Launder clothes before reuse.

Ingestion — For advice contact Poison's Hotline Australia Wide 24/7 on **131 126** or a doctor.

If swallowed do not induce vomiting.





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