Good Practice Guide

ANABP 01Φ (BRAVO™)

bravo™ apple

Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

fruitwest Co-operative Ltd.

This *Good Practice Guide ANABP 01(ᵻ) (BRAVO™)*, published by Fruit West Co-operative Ltd (ABN 39 887 087 320), was compiled by Ms Rachel Lancaster (Environmental and Agricultural Testing Services) from contributions by:

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bravoapples.com.au

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bravo™ apple

Contents

1

Introduction

This good practice guide has been developed to provide apple growers with a concise summary of currently available production information relating to ANABP 01$^{\Phi}$ fruit. Fruit from the ANABP 01$^{\Phi}$ variety which meets specification is marketed as the BRAVO™ branded apple. Good practice in ANABP 01$^{\Phi}$ production contributes to better pack out and better returns.

This good practice guide does not cover marketing of the apple. Enquiries regarding marketing should be made to Fruit West Co-operative Ltd. Fruit West Co-operative Ltd is the exclusive licensee to manage the commercialisation of the ANABP 01$^{\Phi}$ variety in Australia and the marketing of the Australian grown ANABP 01$^{\Phi}$ fruit.

The apple variety ANABP 01$^{\Phi}$ was bred in Western Australia, with commercial production occurring from 2016. The deep burgundy skin colour, with prominent lenticels is a feature of ANABP 01$^{\Phi}$ fruit. BRAVO™ branded apples are crisp and crunchy with a good balance between sugar and acid. Once cut, the creamy white flesh is slow to brown. The juicy and crisp taste combined with the distinctive skin appearance makes ANABP 01$^{\Phi}$ fruit appealing to consumers. The variety is suited to the Mediterranean climate found in the south west of Western Australia and is grown in Pemberton, Manjimup, Kirup, Nannup, Donnybrook, Newlands and Karragullen. The ANABP 01$^{\Phi}$ variety is also grown in Arthur's Creek (Vic), Orange (NSW), Officer (Vic), Invergordon (Vic), Shepparton (Vic), Batlow (NSW), Stanthorpe (Qld) and Adelaide Hills (SA).

ANABP 01$^{\Phi}$ was bred in **Western Australia**

Bold. Daring. Different.


bravo

2

History of ANABP 01Φ variety breeding

ANABP 01Φ originated from a cross between the apple varieties Cripps Red and Royal Gala. The cross was made in 1992 by the Department of Primary Industries and Regional Development (DPIRD). The parentage of ANABP 01Φ is shown in Figure 1.

ANABP 01Φ is a 100% non-GM variety. The variety is protected by Plant Breeder's Rights and is owned by the Western Australian Agriculture Authority.

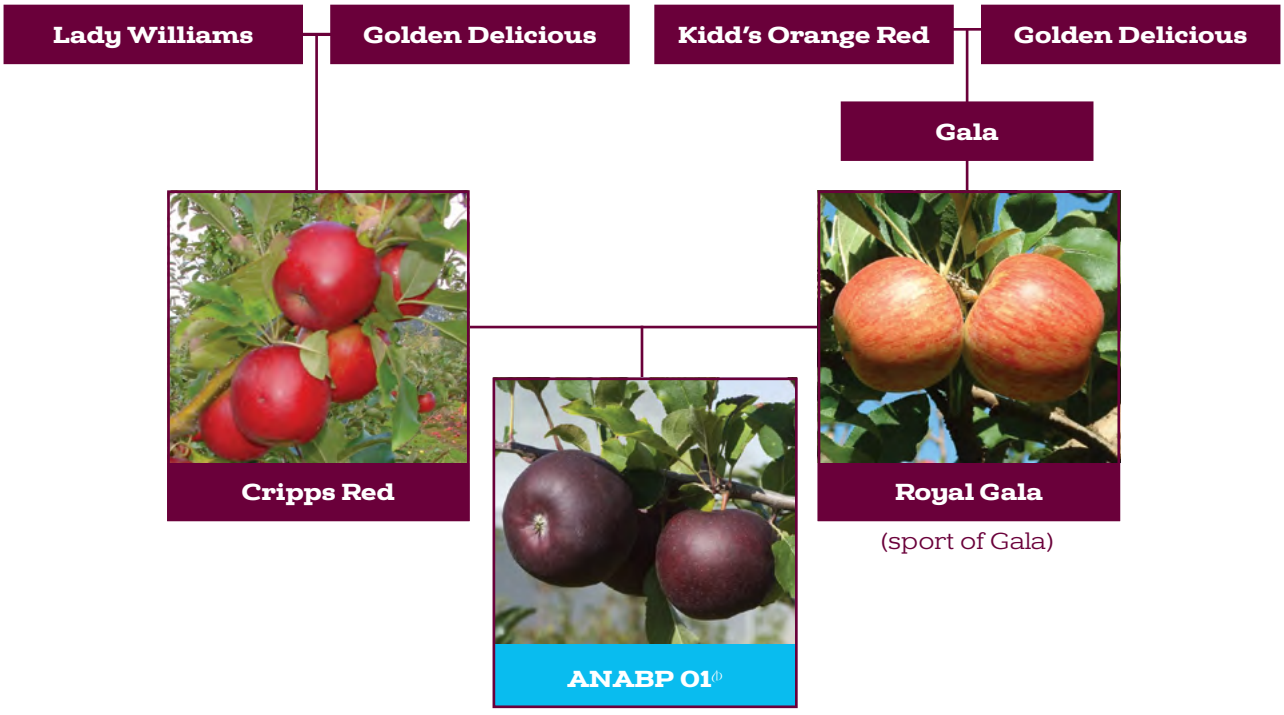


FIGURE 1 The ANABP 01Φ family tree (Source: DPIRD)

3

Growing requirements for ANABP 01$^{\phi}$ variety

ANABP 01$^{\phi}$ grows well in regions with long warm summers, allowing the development of the intense dark burgundy colour as the fruit matures.

Root stocks

ANABP 01$^{\phi}$ has been grown on MM106 and M26 rootstock with success in Western Australia, however the choice of rootstock depends on the orchard management system, soil fertility and planting site history.

ANABP 01$^{\phi}$ is also being grown on the rootstocks MM104, MM109, MM111 and M9 in commercial orchards. More information on preferred rootstocks for all growing regions will become available as ANABP 01$^{\phi}$ on these rootstocks comes into full production.

Fumigation of the soil along the tree line should be considered as tree growth response can be improved after fumigation.

Flower development

The timing of flowering is largely dependent on climatic conditions experienced during winter and spring. The number of days after 1st September to reach various stages in the development of ANABP 01$^{\phi}$ flowers are shown in Figure 2. There is variation in the number of days to reach key stages between location and even between orchards within the same location.

The microclimate of an orchard's location will influence flower development and impact on the number of days required to reach development stages. There may be up to two weeks difference between locations in fruit maturity due to variations in local climate. It is important to monitor the progress of fruit growth throughout its development from flowering to maturity.

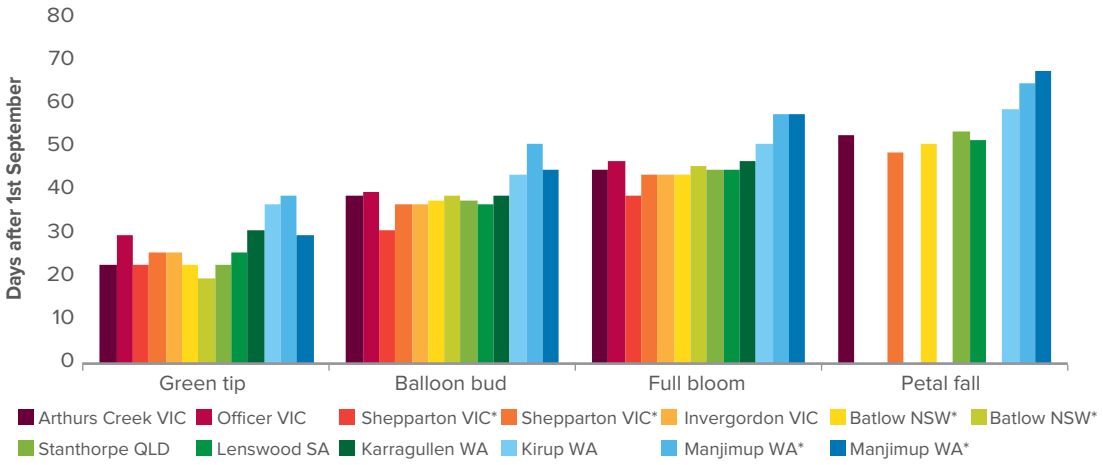


FIGURE 2 Flowering stages for ANABP 01$^{\phi}$ variety. Each stage of development is the number of days after 1st September for different locations

* Data is shown for different growers where the locations are the same.

Prolonged flowering in the ANABP 01$^{\Phi}$ variety can occur for up to five weeks post full bloom. Flowering can be influenced using dormancy breaking chemicals prior to budburst, reducing the occurrence of late flowering.

Fruit from late set flowers can occur on new green shoots ('rat's tails'). Remove these fruit as they are not true to type. The fruit are easily seen once first flowering has passed, due to the late flowers. Fruit that form from late flowering tend to be bitter, conical in shape and are a slightly different colour (not the dark burgundy BRAVO™ colour).

Defoliation of trees

Compared to other varieties, ANABP 01$^{\Phi}$ tends to keep its leaves on the tree for a relatively long time. This reduces the tree's exposure to chill time which may lengthen the flowering period. Defoliation of trees with post-harvest sprays to remove remaining leaves may be required to allow full dormancy to occur.

Products that can be used to defoliate ANABP 01$^{\Phi}$ include:

- Ethrel® (active ingredient 480 g/L Ethephon)
- Sulphate forms of zinc ($ZnSO_4$), iron ($FeSO_4$), manganese ($MnSO_4$) and magnesium ($MgSO_4$), which can also help to correct nutrient deficiencies
- Urea

Multiple applications of defoliation products may be required. Refer to your consultant for detailed information on the timing, concentration and application rates of defoliation products.

Pruning of ANABP 01$^{\Phi}$ variety

The establishment of a tree structure to allow maximum light interception for ANABP 01$^{\Phi}$ fruit colouration is critical to achieving the BRAVO™ colour specification. Good tree structure also reduces the risk of blemishes and damage occurring on the fruit from congested branches.

The ANABP 01$^{\Phi}$ variety is adaptable to a range of growing systems, depending upon the rootstock, environment and grower preference. As the trees mature at five to six years of age, improved fruit colour and quality occurs as intensive nutrient programs aimed to promote tree growth are reduced.

During tree establishment and pruning, consider the following:

- Prune the tree so it has an open structure to increase light interception around fruiting wood (Figure 3)
- Complete pruning in winter, before flowering, to allow new fruit to have exposure to light from the start of fruit development

FIGURE 3 The branches in red should be removed to reduce competition for space and light

- Avoid summer pruning where possible as fruit which is suddenly exposed to intense sunlight is at risk of sun damage
- Plant growth regulators may be useful, depending upon your orchard conditions and environment, to reduce vigour and foliage to help avoid summer pruning or leaf removal
- Use the full circumference of the leader to direct branches into open space, when pruning and tying down branches
- Remove limbs that are parallel or too close
- Avoid crossing over of limbs from neighbouring trees
- Structure branch direction and angles to create space before the second and third tiers, which will encourage light interception throughout the tree
- Remove fruit buds closer than 100mm (one hand's width) to the leader as this fruit will struggle to colour and is at high risk of limb rubbing
- Give the fruit sufficient space to develop colour to maximise the potential pack out after harvest

Tree dormancy

Dormancy breaking agents should be applied after at least 70% of the average chill hours have been received.

Winter chill accumulation can be calculated using the Dynamic Chill Model, which can calculate chilling in chill portions, chill hours or chill units.

Go to the chill calculator
https://hort-science.shinyapps.io/ChillCalculator

ANABP 01Φ has a moderate chilling requirement, requiring at least 50 chill portions (based on the Dynamic Chill Model). Optimum chilling temperature starts at 6°C. The effectiveness of chilling temperatures is reduced as the temperature approaches -2°C and 14°C. Temperatures greater than 14°C can negate previously accumulated chill hours. Winter chill calculations are taken between 1 March and 31 August each year, using the daily minimum and maximum temperatures.

Wet weather can interfere with the application of dormancy breaking products.

Assessment of the effect of dormancy breaking chemicals on ANABP 01Φ grown on M26 or MM106 rootstock was conducted in Manjimup, WA during 2018 (Table 1).

Waiken® (methyl esters of fatty acids) and Dormex® (hydrogen cyanamide) were applied at different rates and different times, with comparison to untreated (control) trees.

Results from the investigation suggest that dormancy breaking chemicals did not significantly influence the duration of flowering (i.e. the flowering period was not compacted). Waiken® at 35 before expected bud burst (BEBB) reduced the duration of flowering by one day, while Dormex® at 45 days BEBB increased the duration of flowering by four days (Table 2).

TABLE 1 Treatments assessed in a dormancy breaking investigation on ANABP 01Φ trees at Manjimup in 2018

Product	Rate of application (%)	Time of application (days BEBB^)
Control — Untreated	-	-
Waiken®	4	50
Waiken®	4	35
Dormex®	3	45
Dormex®	3	30

^ BEBB: Before expected bud burst

TABLE 2 Results of dormancy breaking investigation on ANABP 01ϕ trees at Manjimup in 2018

Treatment	Full bloom (date)	Full bloom date advanced (+) or delayed (-) compared to untreated trees (days)	Duration of full bloom to last bloom (days)	Flowering duration increased (+) or decreased (-) compared to untreated trees (days)
ANABP 01ϕ on M26 rootstock				
Waiken® at 50 days BEBB^	22/10/2018	+3	14	0
Waiken® at 35 days BEBB^	25/10/2018	0	13	-1
Dormex® at 45 days BEBB^	11/10/2018	+14	18	+4
Dormex® at 30 days BEBB^	15/10/2018	+10	14	0
Untreated (control)	25/10/2018	-	14	-
ANABP 01ϕ on MM106 rootstock				
Waiken® at 50 days BEBB^	29/10/2018	0	11	+1
Waiken® at 35 days BEBB^	29/10/2018	0	10	0
Dormex® at 45 days BEBB^	11/10/2018	+18	18	+8
Dormex® at 30 days BEBB^	19/10/2018	+10	12	+2
Untreated (control)	29/10/2018	-	10	-

^ BEBB: Before expected bud burst

Dormex® caused the full bloom date to be earlier at both application times for both M26 and MM106 rootstocks. Trees treated with Dormex® applied at 45 days BEBB reached full bloom 18 days on MM106 rootstock or 14 days on M26 rootstock earlier than the control trees (Figure 4). Trees that received an application of Dormex® at 30 days BEBB reached full bloom 10 days before the control for both rootstocks.

Waiken® applied at 50 days BEBB on M26 rootstock caused full bloom to be three days advanced compared to the untreated trees.

Early flowering and maturity do not appear to hinder colour development in ANABP 01ϕ.

FIGURE 4 Dormancy breaking product investigation trial on ANABP 01ϕ at Manjimup Horticultural Research Institute. Trees are grown on M26 rootstock. Photo was taken on 9 October 2018

Blind wood on trees

The development of blind wood on ANABP 01$^{\phi}$ has been noted. As trees reach 4 to 5 years of age, blind wood is less likely to occur. In young trees, application of gibberellic acid (GA) or 6-benzyladenine (BA) may assist with reducing the occurrence of blind wood. Growers have reported that zinc and magnesium deficiency may also contribute to an increase in blind wood production in young trees. In order to reduce blind wood ensure that trees are supplied with adequate amounts of zinc and magnesium.

ANABP 01$^{\phi}$ pollinators

The recommended preferred pollinators for ANABP 01$^{\phi}$ have been crab apple varieties Golden Hornet and Manchurian, however growers have reported using the variety Granny Smith in preference. Royal Gala is a poor pollination option due to it being one of the parents of ANABP 01$^{\phi}$. The variety Cripps Pink is not a good pollination option, as there was less than 40% fruit set in pollination studies (Figure 5).

One pollinator tree per 20 crop trees should be planted in a random manner throughout the orchard to achieve even pollination.

Fruit thinning

ANABP 01$^{\phi}$ fruit need light exposure during the growing season to enhance the fruit colour from dark red to the distinctive dark burgundy BRAVO™ colour. Two thinning operations should be considered, with the first to manage crop load and a later thinning to remove poor quality, defective or small size fruit (Figure 6).

Managing crop load through targeted fruit thinning early in the growing season (e.g. November) is important to achieve better fruit size, quality and uniformity at harvest. High crop loads contribute to poor colour development and a dilution of sugars in the fruit as light exposure is reduced.

Thinning during milder conditions can reduce the potential for sun damage. The removal of leaves and excess fruit during hot weather can cause the sudden exposure of remaining fruit to direct sunlight, increasing the risk of sunburn.

Thinning early can increase the probability of a good return bloom the following season.

ANABP 01$^{\phi}$ trees mature from years 5 to 6. Fruit load on young trees before they reach maturity should be about 8 to 10 fruit per cm^2 Trunk Cross-sectional Area (TCA). This equates to about four fruit per cm^2 Branch Cross-sectional Area (BCA) on the first established branches (Figure 7).

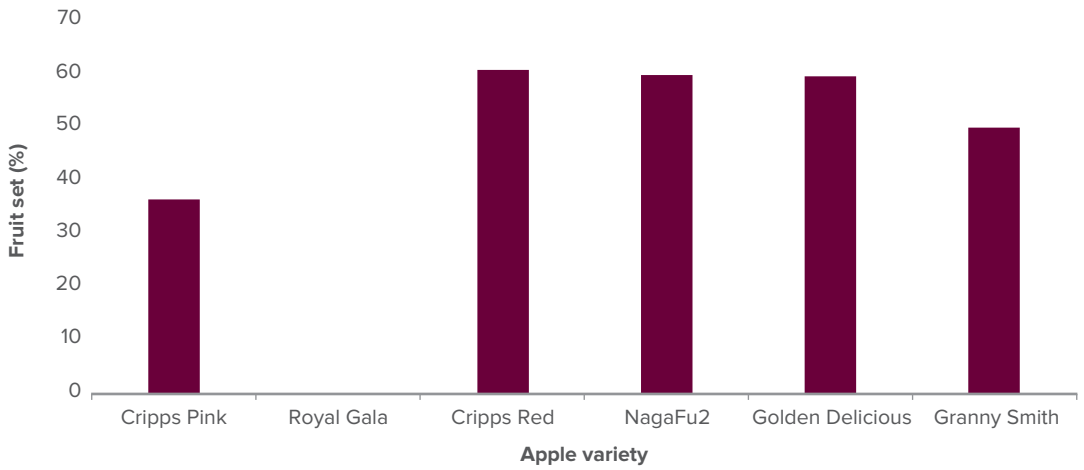


FIGURE 5 Fruit set in ANABP 01$^{\phi}$ using pollen from different varieties

FIGURE 6 ANABP 01$^{\phi}$ before (a) and after thinning (b)

All fruit from the top of young trees should be removed to promote tree growth and development for the first two years. Uniformity of fruit growth and best overall fruit quality will not occur until at least year four, as the trees nutritional demand decreases and less nutrients are applied. It is suggested that a three year old tree have 10 fruit/tree; a four year old tree have 30 fruit/tree, with full production being reached by year six.

Full bloom for ANABP 01$^{\phi}$ is usually from mid to late October, depending upon growing region (see Figure 2). When the king bloom reaches about 6 to 7mm, chemical thinners can be applied based on experience and with caution. Fruit should be thinned when the majority are 5 to 6mm in size as better fruit is produced. Look for eye height fruit when judging size for estimating when to apply thinners.

Fruit set and natural shedding has occurred by four weeks post full bloom, allowing targeted crop thinning to continue.

Fruit size increases by about 5mm per week from fruit set for the first eight weeks. The optimum time for thinning is before fruit reach 30–35mm, which is no later than eight weeks post full bloom.

Prolonged flowering in the ANABP 01$^{\phi}$ variety can occur for up to five weeks post full bloom. Flowering may be compacted through the use of dormancy breaking chemicals prior to budburst, reducing the occurrence of late flowering. Careful application of chemical thinners can be used to remove late flowers.

FIGURE 7 Red fruit to be removed by thinning

Remove fruit from late set flowers, which occurs on new green shoots ('rat's tails') as they are not true to type. Fruit from late flowering tends to reach maturity as a longer, denser and poorly coloured fruit, which does not meet the BRAVO™ specifications.

When hand thinning, remove the late set ('rat's tails') shoots from the apple cluster before choosing the best fruit to retain and thin.

ANABP 01® can set multiple fruit clusters towards the end of limbs and shoots, with less fruiting points towards the trunk.

To achieve growing the majority of fruit in maximum light, which improves colour, best results have been achieved:

- In 3D trained systems by thinning to doubles at the end of branches and singles further into the tree
- In a 2D or double leader growing system good exposure to light and colour can be attained when leaving more doubles

When thinning to doubles:

- Leave two fruit with sufficient space to grow. Remove late set, small, misshapen and damaged apples
- The king bloom may not be one of the best fruit to leave as it can dominate the second fruit for uniform growth and position. This causes varied size and poor colour development where fruit are touching
- There is generally no benefit in leaving the king bloom unless there is sufficient space for both fruit to grow (i.e. the king bloom does not impact on the growth of the second fruit)
- King blooms tend to have thicker stalks, which may increase the risk of stem punctures on fruit during harvest and packing
- King blooms tend to have a slightly elongated fruit shape. The use of Cytolin® to lengthen and soften stalks and give flexibility to the skin may cause the fruit shape to become too elongated by harvest time

When thinning to singles within the tree canopy:

- Enhance colour development by leaving the best fruit in the most open position
- Leave space for the fruit to grow and reduce the risk of rubbing blemishes and injury on the fruit by:
  - Avoid leaving fruit within one hand width (100mm) of the trunk
  - Ensure the selected fruit is growing away from limbs and wires

Thinning to triples is not recommended as the bottom most fruit is shaded and may not meet the colour specification for BRAVO™ fruit. The colour and size of the upper fruit in a triple is also compromised, increasing the risk of all the fruit in the triple not reaching BRAVO™ specifications.

Go to the technical note on thinning of ANABP 01®
www.fruitwest.com.au/index_htm_files/BRAVO%20Technical%20note%20Thinning_HR.pdf

BRAVO™ fruit diameter
72–81mm
(market preferred)

Fruit size

Young trees tend to grow larger fruit than mature trees. Heavy fertiliser application during tree establishment and early growth (up to four years after planting) can cause large fruit. Fruit size is reduced as fertiliser application is lower in mature trees.

Fruit size increases by about 5mm per week from fruit set for the first eight weeks (Figure 8).

Fruit thinning can be used to regulate final fruit size. Reduced thinning produces smaller fruit due to the increased competition between the growing fruit. If over thinning occurs, the remaining fruit size will be larger.

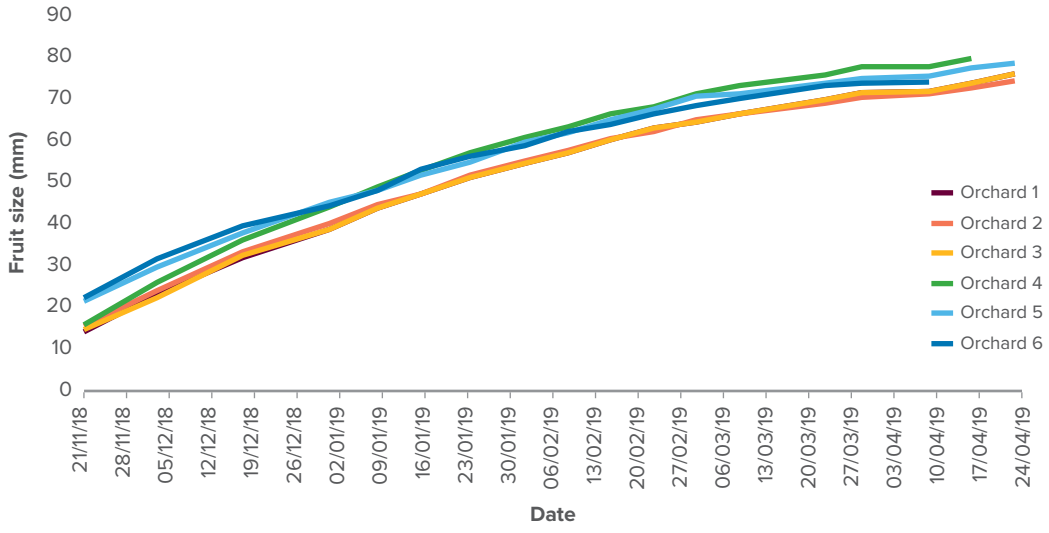


FIGURE 8 Increase in fruit size, measured weekly, Manjimup, WA

Fruit colour

Tree maturity is five to six years of age. Peak yield and fruit colour development is not expected to reach full potential until this time (Figure 9).

Optimisation of fruit colour to meet the BRAVO™ specification relies on adequate light exposure of the developing fruit.

To optimise colour development:

- Prune trees during winter to an open shape that maximises light interception
- Conduct thinning operations early (no later than November), to maximise light interception and reducing sunburn risk
- Use reflective matting beneath the trees

Grower observations indicate that cooler nights can assist to improve fruit colour. The temperature differential that occurs after overhead irrigation cooling in summer, used to manage sun damage on fruit can also improve fruit colour.

Reflective matting

Reflective matting can be used to improve colour in the first harvest (Figure 10).

Growers observations suggest that reflective matting may enhance colour development in ANABP 01$^{\Phi}$, however there has been varying success using reflective matting ranging from no difference to improved colour.

FIGURE 10 Reflective matting in ANABP 01$^{\Phi}$ orchard

The apple variety has a bearing on whether reflective matting will be useful. Growers have reported that the Gala variety responds well, with about 75% of fruit being removed at the first harvest.

The value of installing reflective matting depends upon the likelihood of colour development occurring adequately in the fruit, with consideration of tree pruning, fruit thinning and the associated light interception. Orchard location and environment can also impact on the success of reflective matting to improve fruit colour.

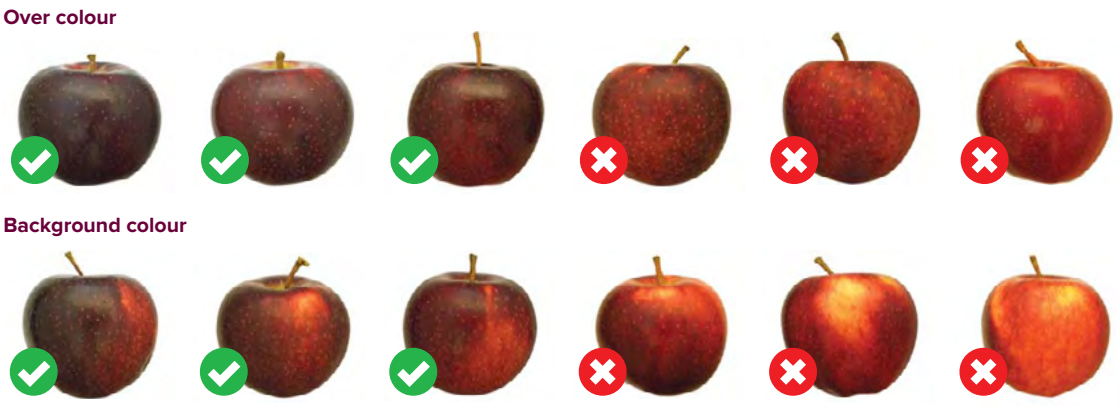


FIGURE 9 Acceptable fruit colour to meet BRAVO™ specification

Consider assessing reflective matting in a small portion of the orchard, if it has not been done before. Use an area of the orchard that is considered 'representative' of the whole orchard. For example, don't put the reflective matting on a sloped area of the orchard if most of the orchard is on level ground. Assessing the potential use of reflective matting in your orchard will help you to decide if the benefit of improved early colour development offsets the installation costs.

Nutrition

Growers have their own preferences in the development of nutritional programs for fruit trees. Grower observations have indicated that ANABP 01$^{\phi}$ should be provided with a nutrition program that is similar to that used for other varieties.

During the growing season, leaf analysis should be used to monitor for trace elements. This can provide an early indication if insufficient trace elements are being supplied, which can affect fruit quality and uniformity at harvest.

Post harvest applications of nutrients are also required, to assist with maintaining tree health prior to dormancy.

Some key observations related to the nutritional needs of ANABP 01$^{\phi}$ are:

- As trees mature at 5 to 6 years of age, intensive nutritional programs used to support young tree growth can be reduced, improving the quality and uniformity of fruit
- Young trees that have received excessive nitrogen to boost tree growth, may suffer from calcium and boron deficiencies
- Young trees require regular calcium and boron applications from early blossom through to six weeks before harvest. The application of calcium and boron products may prevent pitting (Figure 11)

FIGURE 11 Pitting in ANABP 01$^{\phi}$ fruit

- Use chelated calcium for early season applications
- Boron helps to support the uptake of calcium. It is important not to over apply boron, as boron toxicity could occur
- Maintaining adequate zinc levels is recommended to assist in the prevention of blind wood, and to assist with defoliation

Leaf analysis should be used to monitor trace elements

Netting

It is recommended that netting be used to maximise fruit quality and increase pack out return. Netting helps to protect fruit against:

- Sunburn
- Bird damage
- Hail damage

Netting can be either a permanent structure (Figure 12) or applied as drape netting (Figure 13).

It is recommended when planning a new orchard planting arrangement, consideration should be given to future netting requirements, either as a permanent structure or as drape netting.

FIGURE 13 Drape netting in ANABP 01$^{\phi}$ orchard

FIGURE 12 Permanent netting structure in ANABP 01$^{\phi}$ orchard

Netting reduces **sunburn, bird and hail damage**

bravo™ apple

4

Fruit maturity and harvesting

ANABP 01$^{\Phi}$ fruit tend to ripen towards the end of the apple harvest season, about 21 days before Cripps Pink. The actual harvest time is dependent upon seasonal conditions and can vary between years.

Quality specifications for ANABP 01$^{\Phi}$ apples to be sold under the BRAVO™ brand are set each year. Growers should refer to the quality specifications throughout the year and prior to harvest, to determine management practices that will allow fruit to be marketed under the BRAVO™ brand.

Key points of the 2019 premium grade BRAVO™ specifications are:

- **Treatment:** All ANABP 01$^{\Phi}$ fruit must be treated with 1- methylcyclopropene (SmartFresh™) within 7 days after harvest
- **Chemical:** The use of diphenylamine (DPA) is not permitted
- **Wax:** Waxing of ANABP 01$^{\Phi}$ is not permitted unless written authorisation is gained in advance from WA Farm Direct, the licensed marketer of all ANABP 01$^{\Phi}$ fruit
- **Sticker:** All apples meeting the BRAVO™ specification must have a sticker with a Fruit West Co-operative Ltd approved bar-coded BRAVO™ PLU
- **Flesh firmness:** Harvest at a pressure of no less than 7.5 kg although greater than 8.0 kg at harvest is preferred
- **Sugar content:** Total Soluble Solids (°Brix): Fruit should have a minimum of 13 °Brix at harvest, with an average sugar content of 13.5 °Brix or greater is preferred
- **Shape:** Fruit shape should be generally round, with no misshaped/malformed fruit
- **Residues:** There must be no milky coating or surface residues on the fruit
- **Colour:** At least 70% of the surface area of the apple should be dark burgundy in colour. Light red, orange and cream colour should be less than 30% of the fruit surface area
- **Taste:** The eating characteristic of the fruit should be crisp, sweet, firm and juicy and free from foreign taints
- **Size:** The ideal fruit size should be medium to large (72mm to 81mm diameter)
- **Defects:** Specifications for major and minor defects are available
  - Total defects (major and minor) must not exceed 10% (i.e. 10 defective apples per 100). Of the total defects, defects classed as major must not exceed 2%

Go to the specifications for BRAVO™ quality fruit
www.fruitwest.com.au/index_htm_files/BRAVOtm%20Quality%20Specifications%202019%20final1.pdf

Go to the BRAVO™ apple quality specification guide
www.fruitwest.com.au/index_htm_files/Bravo_Poster_A4_PRINTREADY_NoBleed_28022018_EW.pdf

Further comments about fruit:

- Acid levels in harvested fruit should be between 5 g/L and 7 g/L
- Flesh colour should be white to creamy white although this depends upon the stage of maturity
- The flesh should be moderately dense in firmness

Starch production in ANABP 01® can be variable if flowering is prolonged. Variability in maturity reduces as trees become older (greater than 5 years old).

Starch patterns can be used to determine the optimal maturity for harvest (Figure 14). Further information on testing for fruit maturity is available on the Fruit West Co-operative Ltd website.

Go to information on maturity testing
www.fruitwest.com.au/index_htm_files/BRAVO%20Apple%20maturity%20testing%20A4_LR.pdf

BRAVO™ fruit should have a **minimum 13 °Brix** at harvest

FIGURE 14 Starch patterns in ANABP 01®

5

Storage

Measurement of air quality in cool stores is important for the delivery of high quality fruit after storage. Sensors should be installed in cool rooms to measure humidity, carbon dioxide (CO_2) and oxygen (O_2). Measurement of ethylene levels may offer greater insight into storage conditions.

The maximum duration of the storage time for ANABP 01$^{\Phi}$ is yet to be determined. ANABP 01$^{\Phi}$ responds to good temperature and storage management. Step cooling of fruit after harvest to 2–4°C is recommended. Optimum storage temperature is 0.5–3°C. When using controlled atmosphere storage, oxygen should be between 1.5–2.5% and carbon dioxide below 1%, unless ultra low oxygen (ULO) is being used.

It is important to apply pre-harvest on-tree fungicide at the correct time to reduce the risk of rot development in cool storage.

Humidity

Relative humidity in cool rooms used to store ANABP 01$^{\Phi}$ should be 85% to 95%. Low relative humidity (e.g. 70% and below) has been associated with skin shrivel in ANABP 01$^{\Phi}$ (Figure 15).

FIGURE 15 Skin shrivel due to low humidity in cool room

Ethylene

ANABP 01$^{\Phi}$ produces a greater amount of ethylene compared to the apple varieties Gala and Cripps Pink. Gala and Cripps Pink varieties are considered to be moderate ethylene producing varieties. In contrast the apple variety Granny Smith is a low producer of ethylene.

ANABP 01$^{\Phi}$ responds well to the use of SmartFresh™, which must be applied no later than 7 days after harvest.

Ozone

Ozone treatment using commercial ozone generators may extend storage time and manage volatiles, including ethylene, in cool rooms. Ozone reduces the development and spread of rots on fruit as it effects the growth of spores that cause rots. Excessive ozone concentrations can damage fruit.

Ozone is ineffective when applied at the same time as controlled atmosphere (CA). When a cool room is full, ozone should be stopped prior to the application of SmartFresh™. After SmartFresh™ application, ozone treatment can be recommenced.

Further trial work is being conducted on the effectiveness of using ozone in the storage of ANABP 01$^{\Phi}$.

SmartFresh™ application

SmartFresh™ application must be applied no later than 7 days after harvest. The greatest benefit from the application of SmartFresh™ occurs when ANABP 01$^{\Phi}$ fruit is treated close to harvest.

SmartFresh™ is used for both air stored and controlled atmosphere stored fruit.

6

ANABP 01$^{\phi}$ — potential fruit problems

Sunburn

Reduce the risk of sunburn (Figure 16) occurring by:

- Thinning leaves and fruit earlier in the season to prevent the sudden exposure of shaded fruit to sunlight during hot temperatures
- Use netting (either drape nets or permanent structures) to prevent sunburn damage. The colour of the net doesn't matter but the weave density is important. Thicker weave density helps to reduce sunburn occurrences. The light intensity under black netting is less than white netting, however the UV (ultraviolet) light intensity is about the same for both colours

Avoid calcium based sunscreens to prevent sun damage as they are difficult to remove from the fruit after harvest, potentially reducing the pack out of fruit meeting BRAVO™ specifications.

Take care applying late sprays to ANABP 01$^{\phi}$ as they may be visible on the dark coloured skin, and can be difficult to remove, reducing packout.

FIGURE 16 Sunburn on ANABP 01$^{\phi}$

Observations suggest that sunburn may be more severe with trickle (drip) irrigation compared to micro sprinklers.

Residues on fruit/greasiness

Residues on fruit can downgrade the quality of the fruit at packing. Residues may appear from the application of products to the trees prior to harvest such as sunburn preventers, fungicides, trace elements and surfactants additional to those already in products.

Over mature ANABP 01$^{\phi}$ fruit can develop a greasiness on the surface, due to the development of an excessive amount of natural wax. The longer the fruit remains on the tree, the more wax produced, causing a heavier, more noticeable coating. Fruit that is left to develop colour should be closely monitored for the development of starch levels to determine the optimum harvest time, to avoid the development of a heavy wax coating, which can occur in the days prior to harvest. It is difficult to achieve a shine on the fruit during the packing process if it has a heavy wax. The optimum date for harvest should be at the point in which sufficient colour and starch development has occurred, without excessive wax development.

To reduce the potential for residues on fruit:

- Avoid or minimise the use of:
  - additional surfactants,
  - sunburn protection products
- Consider applying pre-harvest fungicide spray rather than post-harvest dips
- Don't let fruit become over mature, to reduce natural wax development

Russeting

Russet is the browning of the skin of the apple from the formation of cork cells (Figure 17). It usually occurs in early fruit development, shortly after full bloom.

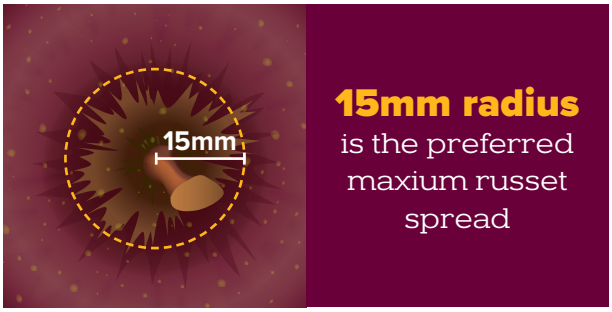
Cork cells are formed when rapidly growing cells under the cuticle (skin) of the apple cause a crack in the cuticle, if it is unable to expand. Cells under the crack die and the repair mechanism of the apple starts the process which leads to the formation of cork cells and associated russeting on the skin.

Cuticle cracking occurs when the internal tissues in the apple grow faster than the cuticle can expand. An apple cuticle is composed of 'wax', which is a mixture of fatty acids, alcohols, paraffins and other compounds.

Once there is damage to the cuticle and the cork cells have formed, wax continues to develop on an apple, however it is formed underneath the russet.

Environmental conditions that contribute to uneven growth of the apple, especially immediately after full bloom can cause cuticle cracking to occur, which leads to russet formation.

FIGURE 17 Russeting in ANABP 01®



The water status of the apple is critical to preventing russet development. Apples that are grown in a humid environment have very little cuticle to protect the flesh. Changes to the water status of apples with a thin cuticle is likely to cause uneven growth and cracking of the cuticle.

Russeting may be caused by:

- Wet weather, heavy dew and high humidity
- Frost
- Low temperatures
- Disease infection (powdery mildew)
- Incorrect concentration of chemical application, caused by measuring incorrect dosage, poor mixing or agitation of chemicals, faulty/incorrectly calibrated spray equipment
- The use of copper, zinc or lime sulphur as a fungicide during flowering and early fruit development
- Heavy nitrogen programs to promote tree growth in young trees, which causes increased fruit cell enlargement
- The use of calcium chloride or calcium nitrate depending upon concentration, temperature and number of applications
- Application of surfactants or oils with chemicals or trace elements
- Unusual weather during or following spraying (e.g. high temperatures or humidity)
- Other environmental or cultural practices that affect the cuticle of the apple

Russeting can be prevented by:

- Maintaining an even water supply to the tree. Prevent water stress from occurring, particularly for about six weeks after petal fall
- Preventing water stress will encourage a uniform growth of cells, reducing the risk of russeting occurring
- Applying a nutrition program during the post bloom period, to encourage the steady and even growth of cells. Do not apply high rates of nutrients irregularly, which can cause growth spurts that can start cuticle cracking
- Maintain adequate levels of calcium, boron and molybdenum. Calcium and boron affect cell division and growth. Molybdenum is required in the nitrogen metabolism process. Adequate molybdenum helps to prevent fluctuations in nitrogen supply to the growing fruit
- Consider using wettable powders for chemicals where possible, as russeting appears to be more likely to occur if using emulsifiable formulations
- Management of fungal infections may help to prevent russeting

Go to the management of russeting in ANABP 01$^{\phi}$ fact sheet
www.fruitwest.com.au/index_htm_files/BRAVO%20Technical%20note%20Russet%20Management_HR.pdf

Fruit cracking

Fruit cracking occurs when fruit is left on the tree into late Autumn and rain is received (Figure 18).

The rapid uptake of water by the fruit leads to the skin splitting.

Water management is essential to prevent fruit cracking occurring, particularly if heavy rain is expected.

FIGURE 18 Fruit cracking in ANABP 01$^{\phi}$

Rots

The correct application time of fungicides to trees is essential to reduce the development of rot (Figure 19). To manage rots, a high standard of hygiene must be maintained in cool rooms.

Core rot

Core rot is a general term that is used for several different types of fungi that are associated with internal rotting in apples. In Western Australia, *Alternaria spp* is the main agent of core rot.

Core rot can be caused by:

- Wet conditions from rain or heavy dew during flowering, which can allow the fungus *Alternaria spp* to infect the fruit.

Core rot in the field can be controlled by an accurately timed and appropriate fungicide program. A high quality orchard hygiene program is important to controlling rot and other diseases in the fruit.

FIGURE 19 Fruit rot on ANABP 01®

Use of Cytolin®

Cytolin®, produced by Sumitomo Chemicals consists of the active ingredients 19 g/L gibberellins A4 and A7 and 19 g/L 6-benzyladenine.

Cytolin® can be applied to:

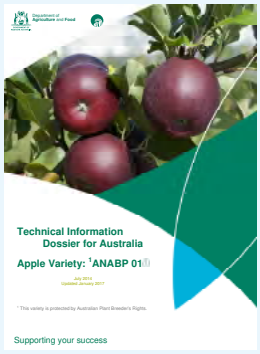
- Influence fruit shape
- Lengthen stalks, reducing the potential for stem punctures
- Improve skin flexibility and protect against weak points
- Assist in reducing russet issues

7

Further information

Further information on ANABP 01$^{\phi}$ can be obtained from the following locations:

- **Fruit West Co-operative Ltd**
  www.fruitwest.com.au/treeoverview.htm
- **Department of Agriculture and Food, Western Australia.** ***Technical Information Dossier for Australia: Apple Variety ANABP 01$^{\phi}$*** **(July 2014, updated January 2017)**
  www.fruitwest.com.au/index_htm_files/31-01-17%20ANABP%2001%20Technical%20Dossier%20Final.pdf
- ***BRAVO™ apple specification guide***
  www.fruitwest.com.au/index_htm_files/Bravo_Poster_A4_PRINTREADY_NoBleed_28022018_EW.pdf
- ***BRAVO™ apple specification 2019 season***
  www.fruitwest.com.au/index_htm_files/BRAVOtm%20Quality%20Specifications%202019%20final1.pdf
- ***ANABP 01$^{\phi}$ Apple Maturity Testing — a Step-by-Step Guide***
  www.fruitwest.com.au/index_htm_files/BRAVO%20Apple%20maturity%20testing%20A4_LR.pdf
- ***Pruning for Packout*** **Technote (2019)**
  www.fruitwest.com.au/index_htm_files/BRAVO%20Technical%20note%20Pruning_HR.pdf
- ***Thinning to Establish Crop Load*** **Technote (2019)**
  www.fruitwest.com.au/index_htm_files/BRAVO%20Technical%20note%20Pruning_HR.pdf
- ***Russet Management*** **Technote (2019)**
  www.fruitwest.com.au/index_htm_files/BRAVO%20Technical%20note%20Russet%20Management_HR.pdf
- **Victorian Department of Primary Industries (2011)** ***Sun Protection Manual for Fruit***
  http://mvcitrus.org.au/mvcb/wp-content/uploads/2012/09/Sun-Protection-Manual-for-Fruit.pdf
- **Queensland Government Chill calculator**
  https://hort-science.shinyapps.io/ChillCalculator



Further information on ANABP 01$^{\phi}$ production is available in the:
Technical Information Dossier for Australia: Apple Variety ANABP 01$^{\phi}$
Department of Agriculture and Food, Western Australia.
(July 2014, updated January 2017)
www.fruitwest.com.au/index_htm_files/31-01-17%20ANABP%2001%20Technical%20Dossier%20Final.pdf

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