



Know-how for Horticulture™

**Breeding and
agronomic evaluation
of tomato cultivars for
fresh market
production in
northern Victoria**

Bill Ashcroft
VIC Department of Primary
Industries

Project Number: VG97085

VG97085

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Final Report

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**Breeding and Agronomic Evaluation of Tomato Cultivars
for Fresh Market Production in Northern Victoria**

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Project Number: VG 97085

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Media Summary

A conventional breeding and field selection program was conducted over six seasons (1997-2003), to identify better fresh-market tomato varieties for both ground and trellis production in northern Victoria. Objectives were to increase fruit size and flavour, introduce a “gourmet” shape, and to incorporate resistances to several diseases.

The ground breeding program resulted in two commercially promising hybrids (AV6 and AV9), one of which (AV9) is resistant to Bacterial Speck. A further 29 hybrids (six with bacterial speck resistance) demonstrated potential for commercial trials. Locally adapted inbred lines, to be used as parents in the production of hybrids, were also developed to incorporate a “gourmet” fruit type (flat-round fruit with long shelf life and small blossom and calyx scars), resistance to bacterial speck, and resistance to Tomato Spotted Wilt Virus.

For trellis, field selection of commercial material demonstrated that most cultivars developed overseas do not meet the requirements of local growing conditions and/or markets. Cultivars Daniela (FA144), Red Ruby and Petula were consistently among the best performers in field trials, and these have been widely adopted by growers. Initial crosses were also made towards the development of locally adapted lines suitable for trellis production.

This project brings an end to a lengthy and significant breeding program for fresh tomatoes in Victoria. The Victorian fresh tomato industry is very small by world standards, and has specialised needs for varieties, arising from environmental as well as market requirements. If the industry is to thrive, regular monitoring should be conducted, to ensure that these needs are being met. The genetic material developed through this program should also be regarded and preserved as a future industry resource.

This work was conducted by the Victorian Department of Primary Industries, with funding support from Horticulture Australia Ltd and the Northern Victorian Fresh Tomatogrowers Association.

Technical Summary

A program of field and glasshouse work was conducted over six growing seasons (1997/98 to 2002/03) in the Goulburn Valley of Northern Victoria, to identify and develop improved genotypes for the fresh market tomato industry. The industry employs both ground and trellis production systems, and the requirements of both were addressed. Conventional hybridisation techniques were used to combine parent lines (developed through pedigree selection) with suitable agronomic or quality characteristics (determined from field and laboratory testing). Throughout the project, selection emphasised stronger flavour and larger fruit size, as well as the incorporation of resistance to Bacterial Speck (through the *Pto* gene). Machine-harvest traits (jointlessness and concentrated maturity), the “gourmet” type (flat-round fruit with long shelf life and small blossom and calyx scars), and resistance to Tomato Spotted Wilt Virus (the *Sw5* gene) also became priorities at various times in the project. All breeding lines were screened in the field against a list of desirable plant and fruit descriptors based on market and grower requirements.

Most breeding work was focussed on varieties for ground production, and drew upon an extensive population of locally adapted inbred lines developed through previous projects. Hybrids were produced as the commercial output of the project, and two - AV6 ((Arcadia X Firefox) X (Arcadia X Aurora)) and AV9 (((Aurora X Ontario 7710) X Aurora) X (Arcadia X Aurora)) - demonstrated commercial potential in replicated field trials, with yield and fruit quality attributes as good or better than industry standards (*cv*'s Rebel, Triumph and Arcadia). AV9 incorporates resistance to bacterial speck (Race 0). At the conclusion of the project, a further 29 hybrids were identified as promising for commercial development – 6 incorporating resistance to bacterial speck (Race 0). Locally adapted breeding lines were also developed with gourmet fruit shape (F_6), bacterial speck resistance (F_6) and TSWV resistance (F_3). Multi-variate analysis of fruit and plant characteristics revealed that both inbred families and hybrids developed through the program were better aligned to desirable ideotypes than current industry standards.

Several major growers moved to a trellis production system in response to market signals in 1997, prompting the need for locally adapted varieties with semi- and indeterminate habits and the flatter “gourmet” fruit type. Replicated and observation field trials were conducted to evaluate commercially available cultivars for trellis production. Cultivars Daniela, Red Ruby and Petula were found to meet the requirements of growers and markets - particularly in terms of yield, fruit shape and size – most consistently, and these have been widely adopted in the region. Initial crosses (to F_3) were also made to develop locally adapted germplasm that could facilitate future breeding of trellis varieties for the region.

This program has generated a significant collection of germplasm that is adapted to semi-arid growing conditions and clay-loam soils, and which could be of value in other scientific programs. It includes some of the most determinate material commercially grown. The maintenance of at least the core families within this collection is recommended, as is the continuation of national and international scientific linkages that could benefit from access to them.

Introduction

Northern Victoria is a major production area for fresh tomatoes in Australia, supplying domestic markets from early January to late April each year. Advantages of the region include a warm, dry climate, abundant irrigation water and proximity to major markets. The industry is soundly based on the latest growing technologies including the use of drip irrigation, black plastic mulch, cell-grown transplants and mechanical harvesting aids. Quality assurance is also practised across the industry in modern fruit grading and storage facilities.

Growers have been quick to respond to market signals, and the industry has changed rapidly over the past ten years, to remain prosperous despite many challenges. While market forces have led to rationalisation and a dramatic decline in grower numbers (now around 30), production continues to expand, and is currently estimated at approximately 40,000t annually, with a farm-gate value well in excess of \$40M. Most fruit is directed to domestic markets, but some (<10%) is exported – mainly to Singapore and New Zealand.

The industry has not always been so prosperous, and its success has been built on the development of locally adapted cultivars and growing techniques. The cultivar “Arcadia” in particular was bred specifically to meet local growing conditions and market requirements, and underpinned an industry resurgence in the early 1990’s. Arcadia is a “ground” cultivar (ie it has determinate habit and does not require trellising) with very firm, attractive and durable fruit on a plant that is compact and easy to manage in the field. On the negative side, Arcadia fruit tend to be mainly of medium size and can lack flavour. The foliage of Arcadia plants is also susceptible to bacterial speck (caused by the bacterium *Pseudomonas syringae* pv *tomato*).

Recognising the need for on-going cultivar development, growers (through the Northern Victorian Fresh Tomato Industry Development Committee) financially supported a research program which commenced in 1991 (HRDC projects VG122 and VG411). The aim of the program was to develop and introduce improved cultivars for production in northern Victoria by means of traditional pedigree breeding and field selection of improved genotypes. In practice, this meant that regionally adapted cultivars were hybridised with lines showing improved quality or field characteristics. Arcadia was often used as a parent, and selections offered improved flavour and slightly larger fruit than Arcadia, but were slightly later maturing and retained susceptibility to Bacterial Speck. In addition to plant breeding activities, commercial cultivars provided by seed companies were screened annually in replicated and observation field trials, to identify those most suitable for local production.

Increasing demand for quality fruit on domestic as well as export markets continues to drive industry expansion. Fruit requirements are also changing in response to consumer and retail demands for improved quality and differentiated products. This was well illustrated in the late 1990’s, when major supermarket buyers demanded a new style of tomato (branded as “gourmet”), leading many growers in northern Victoria to move to a trellis production system.

Australian consumers prefer tomatoes to be firm, of medium-large size, and to have good flavour (Beattie et al., 1983). Firm-fruited cultivars have been widely grown in Australia since “Flora Dade” was introduced into Queensland from the USA in 1973 (McGlasson, 1989), and some now include genes which inhibit the ripening process (such as *nor* and *rin*), thereby prolonging shelf-life (Nguyen et al., 1991). While firm cultivars are attractive and have good keeping qualities, many have drawn criticism

for lacking flavour (Hobson, 1988). This has been related to the fact that such cultivars feature thick fruit walls with small locules (Stevens, 1979).

Growing conditions vary widely around Australia, and tomato breeders have developed a range of cultivars to meet specific requirements relating to the prevailing environment and disease pressures (McGrath, 1988; Nguyen, 1991a; Nguyen, 1991b). Inland production areas frequently experience high temperatures, in which fruit ripen quickly, and can become too soft for marketing. Arcadia was selected under these conditions (Ashcroft et al, 1993), and although it proved commercially successful, both its small fruit size and lack of flavour were recognised deficiencies. Arcadia is also very prone to damage from bacterial speck. While the chemical basis for tomato flavour is complex, there is great potential for its improvement through breeding. Resistance to bacterial speck (caused by *Pseudomonas syringae pv tomato*, Race 0) in *Lycopersicon esculentum* has been attributed to a single dominant gene (*Pto*) (Pitblado and Macneill, 1983), and as such, could be readily transferred into commercial lines through a conventional breeding program. Race 1 of this disease has also been detected in northern Victoria (Tesoriero, 1996), and although this is a concern in the longer term, resistance to Race 0 is still seen as a major advantage.

During the course of this project, many growers made the transition from ground to trellis production systems, and then the industry endured a major outbreak of Bacterial Canker (caused by *Clavibacter michiganensis*) in 1998. Western Flower Thrips (WFT) were identified in northern Victoria in 2002, prompting fears of a major outbreak of Tomato Spotted Wilt Virus (for which WFT is a potent vector). Field activities and industry priorities for cultivar development reflected these events, with restricted farm access for trials and emerging needs to improve genotypes for trellis, to develop “gourmet” style fruit for ground production, and to generally scale back the ground breeding program. Jointless ground cultivars that might be amenable to machine harvest were also investigated over several seasons in response to spiralling harvest labour costs.

In this context, the current project was conducted over six seasons (1997/8-2002/3), and addressed the following breeding and selection targets:

Primary selection criteria:

- Larger fruit
- Improved flavour
- Resistance to Bacterial Speck (Race 0)

Other objectives that were identified during the project:

- Suitability for machine harvest (jointless with concentrated maturity)
- A “gourmet” fruit shape for ground production
- Resistance to Tomato Spotted Wilt Virus (TSWV)

Government funding of breeding programs was also closely scrutinised over this period, with reviews of fresh tomato breeding by HRDC/HAL in 1999 (Lawrence, 1999) and 2002 (Biggs and Titley, 2003). Originally developed to run for five years (1997-2002), the project was extended while the long-term future of the program was decided.

Materials and Methods

The breeding, selection and evaluation of cultivars conducted within this project are a continuation of earlier work (reported through projects VG122 and VG 411).

Throughout the project, selection emphasised stronger flavour and larger fruit size, although Bacterial Speck resistance, machine-harvest traits (jointlessness and concentrated maturity) and the “gourmet” shape also became priorities in response to industry and/or market pressures.

Conventional hybridisation techniques involving hand crossing were used to combine parent lines with suitable agronomic or quality characteristics (determined from previous field and laboratory testing). Typically these crosses were made in a glasshouse during the winter and spring months. Progeny from these crosses were then either stabilised through four to five generations in the field as “open pollinated” (OP) or inbred parent lines through pedigree selection, or screened directly as an F1 hybrid in the case of an inbred cross. The latter approach was preferred as a faster means of producing commercial cultivars, because it safeguarded intellectual property generated through the project, and since hybrids are the most viable commercial output from a breeding program.

Experimental lines bred within the program, as well as new cultivars collected from commercial and research sources in Australia and overseas, were planted in the field and assessed under the commercial management conditions in northern Victoria. These include the use of buried drip irrigation and black plastic mulch. Seedlings were transplanted in single rows, into raised beds with centres 1.5 metres apart. Plot sizes varied according to purpose and availability of seed, but replicated plots were routinely 10 m long. While the project initially focussed on ground types, emphasis shifted from 1997 to reflect the industry move to trellis production. Breeding was primarily directed towards determinate types, with an initial priority on selection of suitable commercial indeterminate material for trellis.

Trial Structure

Initial screening of inbred breeding and commercial lines was through unreplicated observation plots established on the DPI site at Tatura. Promising material identified in these plots was then planted in replicated trials both at Tatura and on various commercial properties in the district. Fruit productivity and quality data from these trials was collected for statistical analysis using ANOVA and REML procedures in Genstat (Lawes Agricultural Trust, Rothamsted Experimental Station).

Field Selection Criteria

In the field, plant and fruit characteristics were visually assessed in all plots (see Table 1, Appendix 2). For determinate (ground) types, a low, compact vine with medium vigour was preferred as it provides cover for the fruit, is easy to manage and can be picked repeatedly without undue damage to the plant. Medium vigour was also sought in indeterminate (trellis) plants, to provide adequate cover for fruit while minimising pruning requirements. Various foliar diseases were also evident during the course of the project – including bacterial canker (caused by *Clavibacter michiganensis*) and powdery mildew (*Oidium spp.*). Susceptibility to these and other field problems (such as heat set) were also considered in selection. For both ground and trellis types, preference was shown for medium to large fruit size (150-180 grams

fresh weight) and uniformity through the plant. The size and indentation of blossom end and calyx scars was also noted, along with any cracking, splitting or cat-facing of the fruit. Symmetrical, oblate (flat-round) fruit were selected, with a preference in trellis for a slightly flatter fruit with an indented calyx scar. A uniform green base colour was selected for both trellis and ground types. For marketing purposes, the trellis fruit “type” became known and promoted as a “gourmet” tomato.

Harvest and Fruit Quality Measurements

Within each replicated plot (approximately 10m long), a 2 metre sub-plot was marked for yield assessment. Sub-plots were centred within the plots except where these areas were atypical - eg due to disease or watering problems. These sub-plots were generally picked 3-4 times over 6-8 weeks according to the rate of ripening, which in turn depended on the weather. All fruit that had ripened to the “breaker” (first colour) stage or beyond were harvested and put through a size grader, separating them into 5 categories:

- Small (<30mm diameter)
- Small-Medium (30-45 mm)
- Medium (45-60 mm)
- Medium-Large (60-80mm)
- Large (>80mm)

Unmarketable fruit (through disease, pest damage, cracking, sunburn or blemish) were also removed and weighed separately.

Bacterial Speck Screening

Screening for the *Pto* gene was conducted according to the method of Laterrot (1985). Plants were grown to 2 true-leaf stage in the glasshouse, when leaves were sprayed to run-off with the insecticide Lebaycid (active ingredient fenthion) at a rate of 150 ml/100l. If necrotic lesions appeared on the leaves after 4 days, the *pto* gene was deemed to be present and the plants were selected.

Laboratory Measurements

A sub-sample consisting of 5 representative fruit at “breaker” maturity stage were taken from each plot at a main harvest (usually the 2nd or 3rd pick, depending on the crop) of trellis and ground crops for laboratory testing. These fruit were stored in paper bags, at a constant temperature of 20°C for six days prior to testing, by which time most had reached full colour. Three fully coloured fruit were then selected for immediate processing. Each fruit was weighed and then tested for firmness using a compression meter as described by Sumeghy et al (1983). The measurement involved placing the fruit on its side into a metal support frame, with the calyx facing to the back of the instrument. A 500g mass was then applied to the tomato for a period of 5 seconds, at which time the compression of the fruit (as registered on a dial gauge) was recorded.

Each of the three selected fruit was then quartered through the calyx scar before juicing. One quarter from each fruit was put through a juice extractor to reduce sample cross-contamination. Half of each fruit (two quarters) was then juiced and a

combined sample collected. The remaining quarters were discarded. The tomato juice was then allowed to stand for approximately five minutes, during which it separated into pigmented and clear layers. For colour measurement, 10 mls of the pigmented surface layer were withdrawn using a calibrated pipette and placed in a petri dish (8 cm plastic). Three measurements were immediately taken on this sample to determine an averaged colour reading using the a/b ratio derived from a L.a.b. scale at C/2° (Nippon-Denshoku, Tokyo). The remaining juice was then filtered through a tissue, folded into four. Soluble solids content of the filtrate was immediately measured using a portable refractometer. A 10ml aliquot of the filtrate was then added to 100mls of distilled water and mixed using a magnetic stirrer. The pH of this sample was recorded as soon as the reading stabilised (approximately 30 seconds). A solution of sodium hydroxide (0.1M) was then added to the stirred solution with an automated titrator, until the pH rose to 8.1. The value of the titre was converted to titratable acidity (as % citric acid) using a conversion coefficient of 0.07.

Seasonal overview

1997/98

General

In total, some 340 breeding lines and commercial varieties were evaluated. As several major growers changed to a trellis production system for the 1997/98 season, preliminary trials were conducted to screen material that could be suitable for growing on trellis in the region. Fifty lines were screened, and while half of these were commercially available, many of the rest were identified from earlier trials, where they appeared to have vine types too large for ground production.

Germplasm Development

Crossing program: 60 crosses were made during winter of 1997, emphasising fruit size, flavour and resistance to bacterial speck.

Breeding Line Selection: 170 breeding lines (F2-F6) were evaluated in observation plots at Tatura.

Germplasm Evaluation

Advanced Breeding Line Evaluation: Twelve determinate lines, including commercial standard varieties (Arcadia, Triumph and Waratah) were assessed in replicated trials on commercial properties near Tatura and Byrneside.

F₁ Hybrid and Commercial Variety Evaluation: From the crossing program, 60 F₁ hybrid combinations were evaluated in observation trials at Tatura. Assessment of commercial material for ground and trellis production continued, with 38 and 24 lines evaluated respectively in observation trials at Tatura (ground and trellis) and Wahrung (trellis).

1998/99

General

As the industry shift to trellis production gained momentum, growers through the NVFTIDC were keen to see more emphasis on trellis-type material in the program. Work also continued to develop large-fruited bush-type cultivars with enhanced flavour and bacterial speck resistance. In an experiment related to this project, the post-harvest attributes of 3 trellis lines and 3 bush lines were also assessed under three storage regimes designed to simulate local marketing, export marketing with air transport and export marketing with sea transport.

Germplasm Development

Crossing Program: 30 crosses were made to incorporate locally adapted germplasm (cv. Burnley Bounty, cv. Arcadia, advanced breeding lines) and bacterial speck resistance (from parents Ontario 7710 and Rehovot 13) into promising indeterminate cultivars. Three determinate crosses were made to generate promising F1 hybrids identified in the previous season.

Breeding Line Selection: 208 determinate and 30 indeterminate breeding lines were screened in observation trials established at DPI Tatura during November.

Germplasm Evaluation

Advanced Breeding Line Evaluation: Nine determinate varieties including commercial standards (Waratah, Arcadia and Triumph) were planted in replicated trials at two commercial sites near Arcadia and Undera during October and November. Observation plots of the same lines were also established at Byrneside and DPI Tatura.

F₁ Hybrid and Commercial Variety Evaluation:

Indeterminate: Six commercial indeterminate varieties were planted in a replicated trial at Lancaster during November. Observation plots of the same lines were also established at Murchison East, Mooroopna and at DPI Tatura. The replicated site was not harvested due to a severe out-break of bacterial canker, although fruit quality attributes were assessed. A further 75 commercial indeterminate varieties were evaluated in an observation trial established at DPI Tatura during November.

Determinate: 39 commercial determinate varieties were also assessed along with three F1 hybrid combinations in an observation trial at DPI Tatura.

A post-harvest storage trial was also conducted in 1998/99, as part of a separate project. Fruit from commercial ground (Arcadia, Triumph and Waratah) and trellis (Daniela, Mercedes and FA 870) cultivars were harvested in the field at breaker maturity stage, and then stored to simulate local and export market chains as follows:

1. Fruit assessed immediately after harvest
2. 4 days at 12°C followed by 3 days at 20°C
3. 1 week at 20°C
4. 3 weeks at 12°C followed by 3 days at 20°C.

1999/2000

General

Emphasis continued on the evaluation of trellis-type material and the development of large-fruited ground-type varieties. Because of hygiene concerns related to bacterial canker, there were no on-farm trials established with the major commercial growers this season. Instead, a dedicated trellis evaluation site was established on a small commercial block at Kialla West, where the most promising trellis varieties were evaluated for yield and fruit quality in a replicated trial with three planting dates. This activity was also supported with funding from seed suppliers. Other varieties were also assessed in an observation trial on the site. Evaluation of bush-type material (including promising hybrids) was undertaken in replicated and observation trials at DPI Tatura.

Germplasm Development

Crossing Program: During the winter of 1999, 48 determinate crosses for F1 hybrid generation were made in the glasshouse at Tatura. Selection of parents emphasised the move to F1 hybrid production – with the use of promising local breeding lines as well as FL lines containing the crimson (*og^c*) gene (ie. high in the pigment lycopene). Two crosses were made for indeterminate breeding line development.

Breeding Line Selection: Breeding lines were selected from a large observation trial established at ISIA Tatura, and comprising 33 indeterminate and 131 determinate breeding lines.

Germplasm Evaluation

F₁ Hybrid and Commercial Variety Evaluation:

Determinate: Five determinate varieties made up of industry standard varieties (Waratah, Arcadia and Triumph), a promising new commercial line (Rebel) and a hybrid from the breeding program (T9735 – ((Arcadia X Momotaro) X Arcadia)) were planted in a replicated trial at DPI Tatura. The trial was harvested two times and evaluated for yield, fruit quality and plant morphology. A total of 48 determinate hybrid combinations were also assessed in an observation trial at DPI Tatura planted in November. Results of this trial were used to select a core group of inbred lines that exhibited superior combining abilities.

Indeterminate: Fifteen indeterminate cultivars were planted in replicated trials with three planting dates (in October, November and December 1999) at Kialla West. Seedlings for these trials were raised commercially (at Howlong nursery) and the crop was grown to a good commercial standard. Plots consisted of 35 plants with in-row spacing of 33cm. Each planting was harvested approximately weekly once fruit began to ripen, and was evaluated for yield, fruit quality and plant morphology. Unfortunately, fruit from the last planting was stolen from the plots so that an accurate estimate of yield could not be made. A further 87 trellis varieties were also planted in an observation trial at the Kialla West site during November 1999. Observation plots consisted of 22 plants spaced at 33 cm. The potential of these varieties for local production was assessed as an overall rating out of 10, taking into account industry input from a well-attended field day at the site.

2000/01

General

The commercial assessment of larger-fruited determinate hybrids with elevated soluble solids continued, along with field testing of hybrids with resistance to bacterial speck (race 0). Selection of “ground gourmet” (bush tomatoes with a flat-round shape) breeding lines and trellis varieties with local adaptation also continued. New crosses were made to incorporate field resistance to foliar diseases (Bacterial speck races 0 and 1) and Tomato Spotted Wilt. Observation trials were conducted to evaluate commercial ground and trellis lines.

Germplasm Development

Crossing Program: In total, 95 crosses were made during the winter of 2000. Emphasis was placed on multiplying seed from the 8 determinate hybrid combinations that showed promise in the previous season, creating hybrids with resistance to bacterial speck (Race 0), and making initial crosses to incorporate resistances to tomato spotted wilt and race 1 of bacterial speck. Some crosses were also made to incorporate novel colours into locally adapted breeding lines.

Breeding Line Selection: A total of 91 determinate and 94 indeterminate breeding lines were screened for bush and fruit morphology in observation trials at DPI Tatura.

Germplasm Evaluation

F₁ Hybrid and Commercial Variety Evaluation:

Determinate: 73 new determinate hybrid combinations were planted in an observation trial at ISIA Tatura. A replicated trial was established at three commercial sites as well as at ISIA consisting of two commercial (Arcadia and Rebel) and the eight best performing hybrids selected from the previous year’s trial (AV’s 1-8). The trial was harvested two times and was evaluated for yield, fruit quality and plant morphology. 20 commercial determinate varieties were evaluated in an observation trial at DPI Tatura.

Indeterminate: An observation trial consisting of 75 commercial indeterminate cultivars was established on a dedicated site at Kialla West. Observations on plant morphology and fruit quality were made during the growing season and varieties were assessed for their suitability to the region.

2001/02

General

Industry requested that determinate hybrid AV6 be screened in larger numbers on commercial properties in the 2001/02 season. No new breeding lines were sufficiently advanced to trial on farm and the hybrids generated last season showed little promise as commercial varieties due to instability of the *Pto* gene in the breeding lines. However, 56 new hybrids generated in the glasshouse during winter were observed in plots at DPI Tatura. Some 50 commercial indeterminate varieties were to be screened at a commercial site near Tatura, but this agreement fell through at the last moment due to circumstances beyond the project’s control. No alternative site could be found, despite the best efforts of the NVFTIDC.

Germplasm Development

Crossing Program: A total of 56 different crosses (see Appendix 2) were made during the winter months, despite some difficulties with greenhouse temperature control leading to late harvesting of seed. These hybrids were generated with the aim of producing varieties with resistance to bacterial speck (Pto gene), Tomato Spotted Wilt (Sw5 gene) and other foliar diseases, as well as to increase fruit firmness (alcoba gene) and internal qualities (og^c gene).

Breeding Line Selection: A total of 76 determinate breeding lines were assessed in a December planting and selected for bacterial speck resistance, fruit shape and uniformity, soluble solids and jointlessness. A total of 46 indeterminate breeding lines were assessed in a November planting at DPI Tatura, concentrating on the selection of dwarf stature which may alleviate some of the pruning burden in trellis crops.

Germplasm Evaluation

F₁ Hybrid and Commercial Variety Evaluation:

Determinate: A trial was established to compare hybrid AV6 ((Aurora X Firefox) X (Arcadia X Aurora)) with the commercial standard cv Rebel in three December commercial tomato crops (CPA, Gillieston Fresh and Eren Bros) as well as at DPI Tatura. These sites were used to promote the new hybrid, and yield and quality data was collected and analysed by REML. A further 56 new determinate hybrid combinations were evaluated in an observation trial at DPI Tatura.

Indeterminate: Commercial variety evaluation did not proceed due to issues beyond the scope of the project.

2002/03

General

A further twelve month extension to this project was negotiated pending a review of tomato breeding, conducted on behalf of HAL, and reported in March 2003. During this period, objectives were to commercially trial determinate hybrids, generate new hybrid combinations (ground gourmets and indeterminate breeding lines), and to select for TSWV tolerance after the discovery of Western Flower Thrips in the Goulburn Valley of Victoria. The incidence of tomato spotted wilt in trials and commercial tomato crops was higher than in previous years, and it is suspected that this is due to Western Flower Thrips, which is a potent vector for spotted wilt. None of the fresh tomato varieties grown commercially at this time has resistance to the virus.

Germplasm Development

Crossing Program: Approximately 12,000 seeds each of determinate hybrids AV6 ((Aurora X Firefox) X (Arcadia X Aurora)) and AV9 (((Aurora X Ontario 7710) X Aurora) X (Arcadia X Aurora)) were generated in the greenhouse at DPI Tatura over the winter/spring months. These hybrids were identified for full commercial trial last season. Trial lots of hybrids AV10, 11, 12, 13, and 14 (refer to Appendix 2 for crosses) identified as promising last season were generated along with a further 88 determinate hybrid combinations which combine gourmet shape with bacterial speck race 0 resistance.

Breeding Line Selection: 102 determinate breeding lines and 32 indeterminate breeding lines were established in an observation trial at ISIA during late November and were selected for medium/large size, elevated soluble solids, gourmet shape, bacterial speck resistance and/or resistance to tomato spotted wilt.

Germplasm Evaluation

F₁ Hybrid and Commercial Variety Evaluation:

Determinate: Approximately 12,000 commercially raised AV6 and AV9 plants were commercially assessed in the December plantings of CPA Packers and Gillieston Fresh Produce, the two largest determinate fresh tomato producers in Victoria. A further 88 new determinate hybrid combinations were evaluated in an observation trial at DPI Tatura.

Indeterminate: Similar difficulties as experienced the previous season prevented evaluation of commercial indeterminate varieties in a commercially relevant environment.

Results

Results are presented chronologically from the first season of the project (1997/8). Parent crosses for all breeding lines listed in this report can be found in Appendix 1, with field trial results in Appendix 2.

1997/98

Despite some hot and windy conditions and uneven watering at several sites, most trials achieved a good commercial standard.

Replicated sites were established on commercial sites at Tatura and Byrneside, to evaluate 12 determinate lines, including the commercial standards Arcadia, Triumph and Waratah. Results are shown in Tables 2 and 3. While both sites were harvested, irrigation problems at Byrneside, exacerbated by hot, windy weather, resulted in some yield losses (refer to tables). Arcadia, T8606A, T9334 and Waratah were the highest yielding cultivars at Byrneside. There were few significant size differences, but in notable quality attributes, T9215 and Vulcan were softer and T9212 and T9343 had higher soluble solids than the standards Arcadia and Waratah. At the commercial site near Tatura, most lines produced statistically equivalent yields (Table 3). All standards were in the high yielding group, as were T8606A and T9334. Vulcan stood out for yield and produced the highest percentage of large fruit, although it was also among the softest, and had a high proportion of unmarketable fruit.

An observation trial was also established at Tatura, comprising 340 plots in total. Most achieved good commercial standard, although irrigation was noticeably uneven at the site, possibly due to line blockages. Corrective actions were taken, and these problems were not considered to have had any influence on selection.

New Crosses

From the new crosses, two F1 plots (designated as T9735 ((Arcadia X Momotaro) X Arcadia) and T9748 ((C33 X Arcadia) X ((Floradade X Arcadia) X Ontario 7710)) attracted particular interest for development as F1 hybrids, with high yields of medium-large sized fruit. A further three crosses (T9703, T9709, T9733 – see Appendix 2 for parent lines) produced large vine-types, suggesting the possibility of further assessment on trellis.

Breeding Lines

A total of 262 breeding lines were screened, with 38 being assessed as promising (rating 6 or more out of 10 based on fruit and bush characteristics). 208 determinate and 30 indeterminate selections were made for advancement to the next generation.

The following advanced breeding lines were rated as promising from the ground observation trial at Tatura: T9204-4-1-2-1-MS, T9334-4-7-1-MSA, T9343-3-2-2-MS, T9343-3-2-5-MS, T9343-3-2-6-1, T9343-3-2-9-MS, T9343-3-3-2-MS, T9343-3-3-3-MS and T9343-3-3-5-1.

Commercial Varieties

Determinate: Commercial ground types were evaluated at Tatura, and three lines – DRD16, DRD28 and V50-5656 – were rated at 6 out of 10 or better, with standards Arcadia and Waratah both scoring 5. DRD16 was noted for flavour, and this is reflected in a high soluble solids measurement (5.7%).

Indeterminate: A trellis management system, established for the first time at DPI Tatura, was planted with over 50 lines, including some older “semi-determinate” selections that were considered too big for ground production. Many lines were immediately eliminated when they failed to develop a vine type suited to commercial trellis systems. A second observation site was established on a commercial block near Wahring, to screen 24 commercial cultivars for trellis production.

The trellis trials at Tatura and Wahring identified Ruby, Enya, Red Bluff, V50-7978-2, DRD 3046, 63-73 RZ, LV 1087 and Nevada as promising for trellis production. These lines rated well at both sites, and produced firm, medium-large sized flat-round fruit with a slight green shoulder on an indeterminate vine-type. Several other lines, including Tango, Red Roy and SPS 982 rated well at one site only. The major commercial variety, Daniela, also rated well (>5) in both trials.

1998/99

This proved a very difficult season, with a major outbreak of bacterial canker (caused by the bacterium *Clavibacter michiganensis*) having significant commercial impact across the region, and also affecting most trial activities – particularly on trellis. Field days were cancelled at all commercial sites (for hygiene reasons). Climatic conditions during the latter half of the season were exceptional, with humidity and minimum temperature values well in excess of the long-term averages.

New Crosses

Thirty-two new crosses were planted for seed propagation at Tatura in 1998/99 – 18 for ground production and 14 for trellis (see Appendix 2). Eighteen were advanced – 15 (T’s 9801-15) for ground and 3 (T’s 9816-18) for trellis.

Breeding Lines

From the breeding program, 238 lines were evaluated in the field, with 11 (advanced breeding lines T9334-2-2-2-ms, T9334-2-2-3-ms, T9334-2-2-3-ms, T9343-3-2-9-ms, T9343-3-3-2-ms, T9343-3-3-3-ms, T9343-3-3-5-1 and T9608-2; plus hybrid crosses T9729, T9732 and T9737) assessed as promising (overall score 6 or more) based on fruit and bush characteristics. In total, 131 determinate and 33 indeterminate plant selections were made for advancement to the next generation.

From the replicated ground trials, three breeding lines (T9202, T9334 and T9343B) proved to be equal or superior in terms of yield and quality to the commercial standards (Arcadia, Waratah and Triumph) (Table 4). These lines were selected as parents for use in F1 hybrid production.

Commercial Varieties

Observation trials for 1998/99 included commercially available cultivars for ground (40) and trellis (73) production. Based on field ratings, the best performing new cultivars (scoring 6 or more) were as follows:

Determinate: SPS 7-377 (released as “Rebel”), SPS 7-207 (Roma), SPS 7208, SPS 901 (Roma)

Indeterminate: Enya, Red Bluff, FA870, Citation, Diploma, H 974578, SPS 820 (Roma), H 984503 (Cherry).

The replicated trellis trial at Lancaster comprised 6 commercially available trellis varieties. Unfortunately yields could not be assessed in this trial due to severe bacterial canker at the site. Fruit quality data was collected however (Table 5), and showed that Enya and Red Bluff were relatively soft when compared with Daniela, Abigail, Mercedes and SPS 982. Daniela and Enya had lower soluble solids than the other four varieties tested, and Daniela and Abigail received the highest field ratings (6) at the site.

Post-Harvest Trial

Fruit quality results from the post-harvest trial (not shown) suggested that colour developed faster in fruit from the determinate varieties. It was also found that cultivars Waratah and Arcadia (both determinate) emerged in the best condition after long term storage, whereas Daniela (indeterminate) and Waratah (determinate) were firmest after short term storage. Soluble solids levels were higher in the indeterminate cultivars irrespective of storage treatments.

1999/2000

This season, trials were restricted to a designated industry site on a commercial property at Kialla West, and at ISIA Tatura.

Conditions presented few problems with some hot weather at the start, a mild mid-season, and average late temperatures. Humidity and minimum temperatures tended to be above long-term averages, and while rainfall events occurred regularly, particularly at the start of the season, they caused minimal damage to the trials and did not disrupt harvest activities. Tomato grubs (*Helicoverpa spp.*) were present across the region late in the season, causing damage to many commercial crops as well as the trials – particularly the second and third plantings at Kialla West. While some damage was evident, it was still possible to evaluate fruit characteristics and yield potential of these trials.

New Crosses and Hybrids

A total of 48 determinate hybrids were evaluated in an unreplicated trial at Tatura, of which eleven (see below) were rated as promising (scoring 6/10 or higher) and six were selected for inclusion in a replicated commercial trial next season. Twenty-one of the new hybrids achieved a field rating of 5 (marginal), ten achieved a field rating of 6 (adequate) and one received a field rating of 7 (good). Inbreds with superior combining ability were identified as Arcadia, Aurora, T8606A, T9204, T9215 and T9334.

<u>Hybrid</u>	<u>Female Parent</u>	<u>Male Parent</u>
H2	T9202	T9334
H3	T9215	T9343B
H6	T9202	T9343B
H8	Arcadia	T9334
H11	T9215	T9334
H16	T9204	T9215
H23	T8601	T9204
H24	T8606A	T9215
H30	T8601	T9343B
H37	T9334	T9343B
H39	T8606A	T9334

Advanced Breeding Lines

The most promising advanced breeding lines for ground production were T9321-2-2-1-2-2, T9321-2-2-2-2-1, T9334-2-2-2-MS-MS, T9334-4-7-1-MSA-MS, T9334-2-2-3-MS-MS and T9343-3-3-5-1-MS. A total of 127 breeding lines were assessed from which 113 selections were made for further evaluation. Thirty-three trellis breeding lines were also assessed at Tatura, from which 102 selections were made.

Commercial Varieties

Determinate: Twenty-eight commercial ground varieties provided by seed companies were screened with four, Rebel, Waratah, TOM 9807 (Roma), SPS 7208 (Roma) achieving higher yield and field ratings than those of standards Triumph and Arcadia. Nine cultivars were also rated as adequate (Triumph, Fantasia, H984504, TOM 9643 (Roma), TOM 9806 (Roma), TOM 9809 (Roma), TOM 9581 (Roma), Early Peel Improved (Roma) and Romba (Roma)).

Indeterminate: A separate report was prepared on the trellis trial at Kialla, and can be obtained from the senior author of this document. Results are summarised within this report as Tables 6-9. The following varieties showed promise in the field trial at Kialla West: Red Ruby, Zorro, Izabella, Mercedes, Petula, H994501, H974579, Merit, TMI 9712, FA852, FA554, TA1135, Y5403, FB6610, FB6611, FB6612, FB6614, T49, SPS193-9, SPS195-9, SPS196-9, SPS198-9, SPS7-631, Showcase, SPS7-413, SPS478-8, SPS798-8, Serenade. No single variety stood out as superior. Overall, the top yields were achieved in Red Ruby, Gabriela, Atlatico, Petula, Daniela, TA 1147, Citation and Zorro.

In the trellis observation trial, 5 entries received a rating of 7, 19 received a rating of 6 and 22 received a rating of 5. Those that scored 7 out of 10 were: Merit from Hendersons, TA 1135 from Novartis (for truss production), FB 6611 from Fairbanks,

193-9 from South Pacific (Roma) and 7-413 from South Pacific (Semi-determinate cherry tomato).

2000/01

The program was reviewed at a meeting of tomato and other industry members at Tatura in August 2000. Results to date were presented to the meeting and possible future directions were discussed. The concept that the program should focus on bush tomato breeding only - with screening of existing (commercial) trellis cultivars - was not endorsed by the meeting who felt that trellis breeding should also be pursued.

Cool wet conditions dominated the early part of this season, and contrasted with above average heat during January and February. Isolated storms caused a few problems late, but conditions were generally mild allowing uninterrupted harvest.

Trials were established for determinate lines at Tatura and three commercial sites (Harston, Gillieston and Ardmona), and for indeterminate lines at Tatura and the industry site near Kialla West.

New Crosses and Hybrids

A total of 73 determinate hybrids, crossed during the winter of 2000 (see appendix), were evaluated at Tatura. None were selected for further commercial trial because of instability of the *Pto* gene in the breeding lines.

The six promising hybrids from 1999/00 were compared with two commercial standards (cv Arcadia and cv Rebel) in a replicated trial with 4 sites. From this, one near-commercial determinate variety was selected for accelerated development. Results are shown in Table 10. The variety (AV6) had similar yield attributes to cv. Rebel but with a higher proportion of large fruit as well as a lower bush habit. The growers that conducted the trials, as well as a commercial seed company, expressed interest in seeing further development of the variety. Statistically, all varieties in the trial were part of the top yielding sub-set apart from AV4. AV6 had a significantly higher proportion of fruit in the medium-large and large grades. All varieties had similar firmness, while seven, including cv Rebel and AV6, had significantly higher soluble solids than the previous standard cv Arcadia.

Advanced Breeding Lines

Altogether, 91 determinate breeding lines were assessed in an observation trial at Tatura, from which 108 selections were made (47 “ground gourmet” fruit types, 16 for large fruit size and 22 for bacterial speck resistance).

A second observation trial at Tatura comprised 94 indeterminate breeding lines, from which 36 selections were made for progression to the next generation.

Commercial Varieties

Determinate: Apart from cv Rebel, none of the 20 determinate varieties tested were considered promising this season.

Indeterminate: Out of the 75 commercial indeterminate varieties assessed, 6 were deemed to be suited to the region, 19 were possibilities and a further 51 were unsuitable. The suitable varieties were: TA1355 and TA1065 (cv Red Ruby) from Syngenta, #2 (cherry), #3 (cherry), #4 (cherry) and #13 (cv Petula) from Rijk Zwaan.

2001/02

Despite some early rain, the season was generally mild with temperatures below the long-term average. This favoured flower set and yields were generally high. There were few grub problems, although Tomato Spotted Wilt Virus (TSWV) caused significant damage to several crops.

New Crosses and Hybrids

The promising determinate hybrid (AV6), was again commercially assessed against the industry standard cv Rebel. The results (Table 11) from trials at four sites (Harston, Gillieston, Tatura East and DPI Tatura) were statistically analysed, and confirmed that AV6 has similar yield, soluble solids, colour and firmness to cv Rebel, but with significantly larger and flatter fruit. AV6 also has significantly lower titratable acidity leading to a significantly greater soluble solids to acidity ratio that has been identified as enhancing consumer acceptance (DeBruyn et al, 1971).

In addition to AV6, five new determinate hybrids (Designated AV's 9-14) from the breeding program were identified for future commercial trial on the basis of industry feedback and descriptor analysis. All contained the *Pto* gene, making them resistant to Race 0 of bacterial speck.

From the breeding program, the fruit and plant descriptors of 56 new hybrid combinations were also characterised.

Advanced Breeding Lines

A total of 139 breeding lines were screened, from which 76 determinate and 31 indeterminate breeding lines were selected for advancement into the next generation.

Commercial Varieties

Some 50 commercial indeterminate varieties were to be screened at a commercial site near Tatura, but the trial had to be abandoned at the last moment due to circumstances beyond the project's control. No alternative site could be found.

2002/03

The season was hot and dry, with strong winds causing damage to some crops. Pest and disease pressures were generally low, although TSWV was again evident, causing significant damage in a few instances.

New Crosses and Hybrids

Results of the trial at DPI Tatura, to evaluate 6 promising hybrids, were subjected to analysis of variance and are summarised in Table 12. While all hybrids had acceptable

bush and fruit morphology, and produced a similar yield, AV6, AV9 and AV14 had significantly higher soluble solids contents and soluble solids to titratable acidity ratios. Both AV9 and AV14 have the *Pto* gene making them resistant to Bacterial Speck Race 0.

Vegetative and fruit descriptors were used to characterise a further 95 hybrids which were evaluated for their commercial potential in observation plots at DPI Tatura. Potential was shown by 29 of these (2 with bacterial speck resistance, 23 with flat-round shape currently favoured by the market and 4 with both) for advancement to commercial trial stage (see below and 2002/03 crosses in Appendix 1).

Gourmet shape: TX 02, 05, 10, 12, 19, 20, 22, 25, 31, 33, 34, 43, 44, 48, 50, 52, 55, 58, 60, 61, 62, 67, 81

Bacterial Speck Resistance: TX 85, 87

Gourmet Shape and BSp: TX 36, 54, 70, 76

Advanced breeding lines:

In total, 82 determinate and 46 indeterminate selections were made from the 102 determinate and 32 indeterminate breeding lines evaluated this season. Selections were made in 35% of the determinate breeding lines and 60% of the indeterminate breeding lines evaluated. Current selections should ensure some heat tolerance as hot, dry conditions prevailed during the growing season.

Promising commercial varieties

No commercial varieties were assessed in the 2002/03 season.

Discussion

Field production of fresh tomatoes in northern Victoria has changed markedly over the past six years, most notably in shifting from the ground to trellis systems. While the majority of crops (>70%) are now grown on trellis, a significant tonnage is still produced on the ground, forming the basis for two distinct industry sectors. The widespread outbreak of bacterial canker (caused by *Clavibacter michiganensis*) in 1998 led to a paradigm shift in grower attitudes to field hygiene, reducing access to crops and to some extent, the exchange of information within the industry. As a consequence of on-going legal proceedings, dealings with one major seed supplier are still affected to this day. Seasonal issues, such as the imperative to identify varieties that could be machine harvested, thus avoiding the threat posed by labour shortages, have also arisen regularly in recent years.

In this context, a project to develop improved fresh tomato varieties for northern Victoria can be called upon to address many aims and expectations. As originally proposed, this project set out to improve fruit size and flavour in determinate varieties through traditional breeding techniques, utilising a well established breeding population of locally adapted material. Lack of resistance to bacterial speck (caused by *Pseudomonas tomato* race 0) was a recognised flaw in commercial cultivars, and this was addressed as a major breeding objective. The shift from production of open-pollinated to hybrid varieties was instigated to expedite the cultivar development process, develop a more commercial product, and to protect intellectual property developed through the project. The move to trellis production was in its early stages when the project was initiated, but it prompted the incorporation of a screening program for commercial material to identify semi- and indeterminate cultivars that best suited the needs of the region, industry and markets. Trellis varieties produced a “gourmet” fruit type, somewhat flatter and with a deeper calyx indentation than traditional ground varieties. During the course of the project, the growing market popularity of “gourmets” led to a search for similar fruit types among the ground breeding lines. Market interest also led growers into production of “roma” and cherry tomatoes, which were also incorporated into screening trials within the life of the project. An initial objective, to identify ground varieties that might be suitable for mechanical harvest, was based on an industry imperative that faded as labour disputes were resolved, but remained as a secondary consideration in the screening program.

So what has this project delivered? For ground production, progress towards the desired tomato variety (original and final ideotypes) can be illustrated graphically. Figure 1 shows the results of a multi-variate analysis of fruit and plant characteristics. This shows that progress towards the ideotype has been made in the later generations (F3 and F6 families). The inbred lines used as parents for hybrid production and the hybrids AV6 and AV9 are similar to their progenitor Arcadia. All of these lines are closer to the ideotype than the commercial standard, Rebel. In terms of fruit size and flavour, the inbred lines and hybrids were superior to the original standard Arcadia (see Figs 2 and 3, and Appendices 2-4).

At the conclusion of the project, two new hybrids (AV6 and AV9) had performed successfully in field tests over several seasons, attracting interest from growers, markets and seed companies. One of these (AV9) is resistant to bacterial speck (race 0). A further 29 hybrids were identified as commercially promising in the final project season – six with bacterial speck resistance.

The screening of commercial trellis cultivars provided the industry with information on over 200 lines from a wide range of seed sources, and confirmed the field

performance and fruit quality attributes of Red Ruby, Daniela and Petula, which growers have adopted for commercial production across the region. Under industry pressure, breeding commenced on trellis varieties early in the project. Starting from scratch, such programs can take years to build a pool of germplasm from which to develop commercially relevant cultivars. A pool of promising F₃ and F₂ material that is locally adapted and suitable for trellis has been developed through this project.

History has shown that changing markets and other pressures require regular changes to the cultivar mix that fresh tomato growers use in northern Victoria. The most recent threat comes in the identification of Western Flower Thrips (WFT) in the region. This insect is a highly adaptable pest and a potent vector for Tomato Spotted Wilt Virus (TSWV). Experience elsewhere demonstrates that WFT can rapidly develop resistance to chemical control measures, and that TSWV can devastate field tomato crops. Seed companies are incorporating genetic tolerance to TSWV into new cultivars, but development of these lines and the selection of those that meet the requirements of Victorian growers, could take several years. Through the project, F₃ lines have been developed containing the *Sw5* gene for TSWV resistance. Material that is locally adapted and contains the *Pto* gene for bacterial speck resistance is also available at F₃.

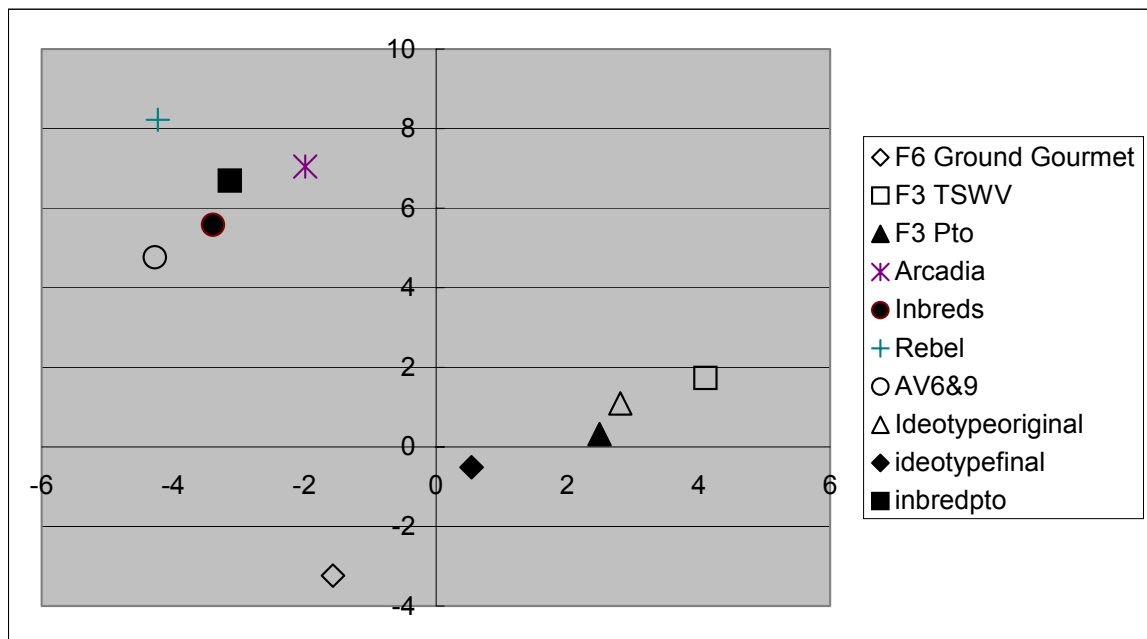


Figure 1: Ordination of breeding families, standards Arcadia and Rebel, and ideotypes based on multi-variate analysis of fruit and plant characteristics. Breeding families are cv Arcadia, inbred lines derived from cv Arcadia (inbreds), inbred lines derived from Ontario 7710 and “inbreds” (inbredpto), Hybrids with commercial potential (AV6&9), F6 generations with gourmet fruit type and determinate habit (F6 ground gourmet), F3 generation with bacterial speck resistance (F3 Pto) and F3 generation with putative spotted wilt resistance (F3 TSWV). Also included in the ordination is the commercial standard Rebel and the ideotypes existing at the beginning and ends of the project (ideotypeoriginal and ideotypefinal).

The commercial development of hybrids AV6 and AV9 was put out to tender by AV Services Pty Ltd after consultation with HAL and NVFTIDC (Appendix 2). As yet, no companies have tendered for the hybrids, although there have been several expressions of interest. General feedback from seed companies indicated that the potential market was not large enough to justify the risk and effort required to produce and market the hybrids. One company (Seminis) has offered to evaluate the hybrids

within their world-wide testing program. Further discussions on the release of the hybrids were undertaken with the Northern Victorian Fresh Tomato Industry Development Committee on Friday 27th June 2003.

The problems in commercialising material from this project may be seen as a failure, but highlight the difficulty that such a small industry (by global standards) faces in gaining access to suitable new germplasm. The ground industry in particular appears vulnerable, and if the supply of new varieties does not keep pace with changing market needs, the demise of this sector will not be long in coming.

Figure 2: Comparison in fruit type between cv Arcadia and Hybrid AV9



Figure 3: Fruit type comparison showing development of ground “gourmets” in relation to the current trellis standard (cv Red Ruby) and other trellis selections



Technology Transfer

Throughout the project, findings were communicated to stakeholders through various activities and media.

Each year, progress reports were presented to the Northern Victorian Fresh Tomato Growers' Association Industry Development Committee, and to the Annual General Meeting of Growers. Written reports were also sent out to all growers (incorporated into the industry newsletter Red Gold News in 1999). Field days were conducted at major trial sites, to showcase promising breeding and commercial lines, provide feedback to seed companies, and obtain validation from growers that selection criteria were appropriate. Local media regularly attended these events. It was not possible to open all field sites for inspection because of concerns about the potential to spread bacterial canker. This led to severe restrictions on access to commercial crops, limiting field days to the designated industry sites at Kialla West and on DPI land at Tatura.

A separate report was compiled to describe results from the trellis trials at the industry site near Kialla West in 1999/2000. Articles were also prepared as listed below:

Popular Press:

2002. Article on breeding for disease resistance in the current project appeared in National Marketplace News.

2003. Articles on hybrids AV6 and AV9 appeared in regional press through *Country News*, on 2nd June and 13th October 2003.

Scientific Conferences:

Breeding and Agronomic Evaluation of Tomato Cultivars for Fresh Market Production in Northern Victoria. W.J. Ashcroft, R.J. Holland, S. Gurban, M.T. Watters and G.R. Ashburner. *Poster Abstract in Proceedings of 4th Australian Horticulture Conference, (October 1998).*

Evaluation of the Victorian Fresh Tomato Breeding Program. G.R. Ashburner, S. Gurban, R.J. Holland, M.T. Watters and W.J. Ashcroft. *Paper in Proceedings of 11th Australian Plant Breeding Conference, Adelaide. Volume 2: pp 245-6. (April 1999)*

Project staff also led efforts to develop linkages between scientists working on fresh tomato breeding across Australia, in line with recommendations from the first review of the subject conducted by Horticulture Australia (Lawrence, 1999). After an initial meeting at Tatura in 1998, fresh tomato breeders from Victoria and Queensland and (initially) South Australia gathered annually to discuss project results and areas for collaboration. From these meetings, a proposal for a national breeding program was developed, which was ultimately unsuccessful in attracting funding support.

Recommendations

Scientific

A significant and valuable germplasm resource has been generated through this project and its predecessors. This material is adapted to semi-arid climates and clay-loam soils. Vine and fruit types vary widely, but include some of the most determinate phenotypes used in commercial production. The latest breeding lines and hybrids also incorporate resistances to bacterial speck and TSWV. This germplasm will deteriorate with storage, and be lost within 5-10 years unless at least the core families are maintained. Opportunities for achieving this should be investigated.

There are several significant risks to tomato production in Victoria that require scientific input. Bacterial canker has already caused major economic loss to the region, and control strategies for this disease, including incorporation of resistance, need to be further developed and tested to minimise future impacts. As noted previously, Tomato Spotted Wilt Virus is a present and increasing problem that also needs integrated solutions – including resistant cultivars. The genetic basis for resistance has been identified for both problems, but to facilitate its commercial application, a regular and systematic evaluation of resistant germplasm under local growing conditions is required. Pruning can spread these diseases, so the use of semi-determinate phenotypes should also be investigated.

Finally, the concept of a national approach to breeding of crops including tomatoes should be pursued, as it offers a means to rationalise specialised equipment and facilities at a time of dwindling resources, as well as providing a valuable forum for exchange of scientific ideas and germplasm.

Industry

In order to satisfy future market demands, Victorian fresh tomato growers will need to have access to a range of cultivars with varied fruit characteristics. These cultivars must be robust and productive under local growing conditions and cultural practices. They should also be resistant or tolerant to seasonal pest and disease pressures.

Growers must remain alert to market signals, and actively pursue the latest cultivars from seed companies, providing feedback to ensure that only relevant material is presented to them.

The breeding lines and hybrids developed through this program represent a significant industry investment, and should also be considered as a resource for the industry's future. While current priorities do not justify further breeding work, consideration should be given to maintaining the most promising families from within this program with regular seed propagation either in the field or glasshouse. Commercial development of the lines showing promise at the conclusion of the program (particularly AV6 and AV 9) should also be pursued as an industry priority.

Genetics should be seen by industry as a vital component in integrated approaches to crop management, pest and disease control. Currently, bacterial canker and TSWV are significant threats, and growers should press for resistance or tolerance to these diseases in any new cultivars promoted by seed companies.

Finally, industry representatives should maintain contact with scientists developing new tomato varieties across Australia and (where possible) overseas, in order to ensure they have access to expertise and the latest in genetics should the need arise.

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Appendix 1: Crosses made

“Historic” breeding lines used

Cross No.	Female Parent	Male Parent
T8601	C33	Arcadia
T8606	Floradade	Arcadia
T9202	Tristar	Aurora
T9203	Aurora	Tornado
T9204	Aurora	Firefox
T9212	Firefox	Aurora
T9215	Arcadia	Aurora
T9334	Arcadia	H2009
T9343	Aurora	Floradade X Arcadia
T9609	Aurora X Ontario 7710	Aurora

1997

Cross No.	Female Parent	Male Parent
T9701	(Floradade X Arcadia)X Ontario 7710	C33 X Arcadia
T9702	(Floradade X Arcadia) X Rehovot 13	C33 X Arcadia
T9703	Arcadia	VF 53 X Arcadia
T9704	Arcadia	CXD 166
T9705	Arcadia	Eagle
T9706	Arcadia	Arcadia X Momotaro
T9707	Ontario 7710 X (Floradade X Arcadia)	Floradade X Arcadia
T9708	Ontario 7710 X (VF 53 X Arcadia)	VF 53 X Arcadia
T9709	Rehovot 13 X (Floradade X Arcadia)	VF 53 X Arcadia
T9710	CXD 166	Arcadia
T9711	CXD 166	D713
T9712	CXD 166	Floradade X Arcadia
T9713	CXD 166	Tristar X Aurora
T9714	CXD 166	Arcadia LFS X BR 84
T9715	CXD 166	Aurora X (Floradade X Arcadia)
T9716	D713	Arcadia
T9717	D713	CXD 166
T9718	D713	Floradade X Arcadia
T9719	D713	Arcadia X Burnley Metro
T9720	D713	Waratah
T9721	Eagle	Arcadia
T9722	Eagle	C33 X Arcadia
T9723	Eagle	Tristar X Aurora
T9724	Eagle	Arcadia LFS X BR 84
T9725	Eagle	Aurora X (Floradade X Arcadia)
T9726	C33 X Arcadia	CXD 166
T9727	C33 X Arcadia	D713
T9728	C33 X Arcadia	Eagle
T9729	Floradade X Arcadia	D713
T9730	VF 53 X Arcadia	(VF 53 X Arcadia) X Ontario 7710

T9731	VF 53 X Arcadia	(VF 53 X Arcadia) X Rehovot 13
T9732	VF 53 X Arcadia	Ontario 7710 X (VF 53 X Arcadia)
T9733	VF 53 X Arcadia	Rehovot 13 X (Floradade X Arcadia)
T9734	VF 53 X Arcadia	Rehovot 13 X (VF 53 X Arcadia)
T9735	Arcadia X Momotaro	Arcadia
T9736	Tristar X Aurora	Eagle
T9737	Tristar X Aurora	Tempest
T9738	Firefox X Aurora	D713
T9739	Arcadia LFS X BR 84	D713
T9740	Arcadia LFS X BR 84	Eagle
T9741	Arcadia LFS X BR 84	Tempest
T9742	Aurora X (Floradade X Arcadia)	Eagle
T9743	Tempest	Arcadia
T9744	Tempest	Tristar X Aurora
T9745	Tempest	Arcadia LFS X BR 84
T9746	CXD 166	C33 X Arcadia
T9747	D713	Aurora X (Floradade X Arcadia)
T9748	C33 X Arcadia	(Floradade X Arcadia) X Ontario 7710
T9749	C33 X Arcadia	(Floradade X Arcadia) X Rehovot 13
T9750	(VF 53 X Arcadia) X Rehovot 13	VF 53 X Arcadia
T9751	Arcadia	D713
T9752	Arcadia	Tempest
T9753	D713	Aurora X Tristar
T9754	D713	Arcadia X Burnley Metro
T9755	C33 X Arcadia	Tempest
T9756	Tristar X Aurora	CXD 166
T9757	Tristar X Aurora	D713
T9758	Tempest	C33 X Arcadia
T9759	Tempest	Floradade X Arcadia
T9760	Tempest	Aurora X (Floradade X Arcadia)

1998

Cross No.	Female Parent	Male Parent
1 (T9801)	Tristar X Aurora (-1)	FA144
2 (T9802)	Tristar X Aurora (-1)	Burnley Bounty
3 (T9803)	Aurora X Arcadia	Burnley Bounty
4	Aurora X Arcadia	Arcadia
5 (T9804)	Arcadia X Aurora	FA144
6 (T9805)	FA 144	Ontario 7710
7	Aurora X Arcadia	C33 X Arcadia
8	C33 X Arcadia	(Floradade X Arcadia) X Ontario 7710
9 (T9806)	Tristar X Aurora (-3)	FA144
10 (T9807)	Ontario 7710	FA144
11 (T9808)	FA144	Arcadia X Aurora
12 (T9809)	FA 144	Tristar X Aurora (-1)
13 (T9810)	FA 144	Aurora X Arcadia
14 (T9811)	FA 144	Tristar X Aurora (-3)
15 (T9812)	Ontario 7710	Burnley Bounty
16 (T9813)	Arcadia X Aurora	Burnley Bounty
17 (T9814)	Arcadia	Burnley Bounty
18 (T9815)	T9203-3	Burnley Bounty

19	Mortgage Lifter	Burnley Bounty
20	Mortgage Lifter	FA 144
21	Mortgage Lifter	Tommytoe
22	Burnley Bounty	Mortgage Lifter
23	Burnley Bounty	Rehovot 13
24 (T9817/8)	Burnley Bounty	FA 144
25	Burnley Bounty	Tommytoe
25 (T9816)	Burnley Bounty	Red Bluff
27	Tommytoe	Burnley Bounty
28	Tommytoe	Mortgage Lifter
29	Lugas	Burnley Bounty
30	Rehevot 13	Burnley Bounty
31	FA 144	Rehovot 13
32	Rehovot 13	FA 144

1999

1	Tristar X Aurora	Arcadia
2	Tristar X Aurora	Aurora
3	Tristar X Aurora	C33 X Arcadia
4	Tristar X Aurora	FloraDade X Arcadia
5	Aurora X Firefox	Arcadia
6	Aurora X Firefox	Aurora
7	Aurora X Firefox	C33 X Arcadia
8	Aurora X Firefox	FloraDade X Arcadia
9	Aurora X Firefox	Tristar X Aurora
10	Arcadia X Aurora	Arcadia
11	Arcadia X Aurora	Aurora
12	Arcadia X Aurora	C33 X Arcadia
13	Arcadia X Aurora	FloraDade X Arcadia
14	Arcadia X Aurora	Tristar X Aurora
15	Arcadia X Aurora	Aurora X Firefox
16	Arcadia X Hz2009	Arcadia
17	Arcadia X Hz2009	Aurora
18	Arcadia X Hz2009	C33 X Arcadia
19	Arcadia X Hz2009	FloraDade X Arcadia
20	Arcadia X Hz2009	Tristar X Aurora
21	Arcadia X Hz2009	Aurora X Firefox
22	Arcadia X Hz2009	Arcadia X Aurora
23	Aurora X (FloraDade X Arcadia)	Arcadia
24	Aurora X (FloraDade X Arcadia)	Aurora
25	Aurora X (FloraDade X Arcadia)	C33 X Arcadia
26	Aurora X (FloraDade X Arcadia)	Floradade X Arcadia
27	Aurora X (FloraDade X Arcadia)	Tristar X Aurora
28	Aurora X (FloraDade X Arcadia)	Aurora X Firefox
29	Aurora X (FloraDade X Arcadia)	Arcadia X Aurora
30	Aurora X (FloraDade X Arcadia)	Arcadia X Hz2009
31	FL7481	Arcadia
32	FL7481	Aurora
33	FL7481	C33 X Arcadia
34	FL7481	FloraDade X Arcadia
35	FL7481	Tristar X Aurora
36	FL7481	Aurora X Firefox

37	FL7481	Arcadia X Aurora
38	FL7481	ArcadiaXHz2009
39	FL7481	Aurora X (FloraDadeXArcadia)
40	FL7547	Arcadia
41	FL7547	Aurora
42	FL7547	C33 X Arcadia
43	FL7547	FloraDade X Arcadia
44	FL7547	Tristar X Aurora)
45	FL7547	Aurora X Firefox
46	FL7547	Arcadia X Aurora
47	FL7547	Arcadia X Hz2009
48	FL7547	Aurora X (FloraDade X Arcadia)
49	Citation	Hz2009
50	Mercedes	Hz2009

2000

	FEMALE	MALE
AV1	FL 7481	Arcadia
AV2	Tristar X Aurora	Aurora X (Floradade X Arcadia)-B
AV3	Aurora	Arcadia X Aurora
AV4	Aurora	Arcadia X H2009
AV5	Arcadia	Arcadia X H2009
AV6	Aurora X Firefox	Arcadia X Aurora
AV7	(Floradade X Arcadia)-A	Arcadia X Aurora
AV8	(Floradade X Arcadia)-A	Arcadia X H2009
	T9708-1-1	Aurora
		Arcadia
		Aurora X Firefox
		(Floradade X Arcadia) -A
		Aurora X (Floradade X Arcadia)-B
		Arcadia X Aurora
		Arcadia X H2009
	T9708-1-2	Aurora
		Arcadia
		Aurora X Firefox
		(Floradade X Arcadia)-A
		Aurora X (Floradade X Arcadia)-B
		Arcadia X Aurora
		Arcadia X H2009
	T9748-1-1	Aurora
		Arcadia
		Aurora X Firefox
		(Floradade X Arcadia)-A
		Aurora X (Floradade X Arcadia)-B

		Arcadia X Aurora
		Arcadia X H2009
	T9748-1-2	Aurora
		Arcadia
		Aurora X Firefox
		(Floradade X Arcadia)-A
		Aurora X (Floradade X Arcadia)-B
		Arcadia X Aurora
		Arcadia X H2009
	T9748-1-3	Aurora
		Arcadia
		Aurora X Firefox
		(Floradade X Arcadia)-A
		Aurora X (Floradade X Arcadia)-B
		Arcadia X Aurora
		Arcadia X H2009
	((Aurora X Ontario 7710) X Aurora) A	Aurora
		Arcadia
		Aurora X Firefox
		(Floradade X Arcadia)-A
		Aurora X (Floradade X Arcadia)-B
	((Aurora X Ontario 7710) X Aurora) B	Aurora
		Arcadia
		Aurora X Firefox
		(Floradade X Arcadia)-A
		Aurora X (Floradade X Arcadia)-B
		Arcadia X Aurora
		Arcadia X H2009
	((Aurora X Ontario 7710) X Aurora) C	Aurora
		Arcadia
		Aurora X Firefox
		(Floradade X Arcadia)-A
		Aurora X (Floradade X Arcadia)-B
		Arcadia X Aurora
		Arcadia X H2009
	Rehovot 13 X (VF53 X Arcadia)	Aurora
		Arcadia
		(Floradade X Arcadia)-A
		Aurora X (Floradade X Arcadia)-B
		Arcadia X Aurora
	H1	Aurora
		Arcadia
		Aurora X Firefox
		(Floradade X Arcadia)-A
		Aurora X (Floradade X Arcadia)-B
		Arcadia X Aurora

		Arcadia X H2009
	Rebel	Arcadia
		Aurora X Firefox
		(Floradade X Arcadia)-A
		Aurora X (Floradade X Arcadia)-B
		Arcadia X Aurora
		Arcadia X H2009
		CXD 206
	((Aurora X Ontario 7710) X Aurora) A	Arcadia X Aurora
		Arcadia X H2009
	Rehovot 13 X (VF53 X Arcadia)	Aurora X Firefox
	Ida Gold	Arcadia
		Aurora X Firefox
	TSWV	Arcadia
	Black Krim	Aurora
		Arcadia
		Aurora X Firefox
		Aurora X (Floradade X Arcadia)-B
	Momotaro	Aurora
		Arcadia
		Aurora X Firefox
		Aurora X (Floradade X Arcadia)-B

2001

	FEMALE	MALE
	FL7481	Arcadia
	Aurora	T9215
	Arcadia	T9334
	T8606A	T9215
	T9202	T9343B
	Aurora	T9334
	T9204	T9215
	T8606A	T9334
	T9708	Aurora
		Arcadia
		T9204
		T8606A
		T9343B
		T9215
		T9334
	T9748	Aurora
		Arcadia
		T9204
		T8606A
		T9343B

		T9215
		T9334
	T9609	Aurora
		Arcadia
		T9204
		T8606A
		T9343B
		T9215
		T9334

2002

TX03

no	Maternal	Paternal
01	T9804-1-3-3	Red Ruby
02	T9804-1-3-3	T9706-1-3-1-MS
03	T9804-1-3-3	T9706-1-3-2-MS
04	T9804-1-3-3	T9706-1-6-1-MS
05	T9804-1-3-3	T9735-2-2-2-MS
06	T9804-1-3-3	T9609-4-1-1-1-1
07	T9804-1-3-3	T9609-4-2-1-1-1
08	T9804-1-3-3	Arcadia
09	T9804-1-3-3	Aurora
10	T9804-1-3-3	Aurora X Firefox
11	T9804-1-3-3	Arcadia X Aurora
12	T9810-4-1-6	Red Ruby
13	T9810-4-1-6	T9706-1-3-1-MS
14	T9810-4-1-6	T9706-1-3-2-MS
15	T9810-4-1-6	T9706-1-6-1-MS
16	T9810-4-1-6	T9748-1-3-1-1
17	T9810-4-1-6	T9609-4-1-1-1-1
18	T9810-4-1-6	T9609-4-2-1-1-1
19	T9810-4-1-6	Arcadia
20	T9810-4-1-6	Aurora
21	T9810-4-1-6	Aurora X Firefox
22	T9810-4-1-6	Arcadia X Aurora
23	T9810-4-1-11	Red Ruby
24	T9810-4-1-11	T9706-1-3-1-MS
25	T9810-4-1-11	T9706-1-3-2-MS
26	T9810-4-1-11	T9735-2-2-2-MS
27	T9810-4-1-11	T9748-1-3-1-1
28	T9810-4-1-11	T9609-4-1-1-1-1
29	T9810-4-1-11	T9609-4-2-1-1-1
30	T9810-4-1-11	Aurora
31	T9810-4-1-11	Aurora X Firefox
32	T9810-4-1-11	Arcadia X Aurora
33	T9810-4-2-6	T9706-1-3-1-MS
34	T9810-4-2-6	T9706-1-3-2-MS
35	T9810-4-2-6	T9748-1-3-1-1
36	T9810-4-2-6	T9609-4-1-1-1-1
37	T9810-4-2-6	T9609-4-2-1-1-1
38	T9810-4-2-6	Arcadia
39	T9810-4-2-6	Aurora X Firefox
40	T9810-4-2-6	Arcadia X Aurora

TX03

no	Maternal	Paternal
54	T9810-4-4-3	T9609-4-2-1-1-1
55	T9810-4-4-3	Arcadia
56	T9810-4-4-3	Aurora
57	T9810-4-4-3	Aurora X Firefox
58	T9810-4-4-3	Arcadia X Aurora
59	T9810-4-6-1	Red Ruby
60	T9810-4-6-1	T9706-1-3-1-MS
61	T9810-4-6-1	T9706-1-3-2-MS
62	T9810-4-6-1	T9706-1-6-1-MS
63	T9810-4-6-1	Arcadia X Aurora
64	T9810-4-8-2	Red Ruby
65	T9810-4-8-2	T9706-1-3-1-MS
66	T9810-4-8-2	T9706-1-3-2-MS
67	T9810-4-8-2	T9706-1-6-1-MS
68	T9810-4-8-2	T9748-1-3-1-1
69	T9810-4-8-2	T9609-4-1-1-1-1
70	T9810-4-8-2	T9609-4-2-1-1-1
71	T9810-4-8-2	T9215
72	T9810-4-8-2	T9706-1-3-1-MS
73	T9810-4-8-2	T9706-1-6-1-MS
74	T9810-4-8-2	T9735-2-2-2-MS
75	T9810-4-8-2	T9748-1-3-1-1
76	T9810-4-8-2	T9609-4-2-1-1-1
77	T9810-4-8-2	Aurora X Firefox
78	T9810-4-9-4	T9722-2-1-1-1
79	T9810-4-9-4	Aurora
80	T9810-4-9-4	Aurora X Firefox
81	T9810-4-9-4	Arcadia X Aurora
82	T9748-1-3-1-1	Red Ruby
83	T9748-1-3-1-1	T9706-1-3-1-MS
84	T9748-1-3-1-1	T9706-1-3-2-MS
85	T9748-1-3-1-1	T9706-1-6-1-MS
86	T9609-4-1-1-1-1	Red Ruby
87	T9609-4-1-1-1-1	T9706-1-3-1-MS
88	T9609-4-1-1-1-1	Arcadia
89	T9609-4-1-1-1-1	Aurora
90	T9609-4-2-1-1-1	Red Ruby
91	T9609-4-2-1-1-1	T9706-1-3-1-MS
92	T9609-4-2-1-1-1	T9706-1-3-2-MS
93	T9609-4-2-1-1-1	T9735-2-2-2-MS

41	T9810-4-3-8	Red Ruby	94	Arcadia	Red Ruby
42	T9810-4-3-8	T9706-1-3-1-MS	95	Aurora	Red Ruby
43	T9810-4-3-8	T9706-1-3-2-MS	96	Rebel	Red Ruby
44	T9810-4-3-8	T9735-2-2-2-MS	97	AV6	
45	T9810-4-3-8	T9748-1-3-1-1	98	T9609-4-2-1-1-1	Aurora X Firefox
46	T9810-4-3-8	T9609-4-2-1-1-1	99	T9609-4-1-1-1-1	Arcadia X Aurora
47	T9810-4-3-8	Aurora	100	T9748-1-3-1-1	Arcadia
48	T9810-4-3-8	Arcadia X Aurora	101	T9748-1-3-1-1	Aurora
49	T9810-4-4-3	T9706-1-3-1-MS	102	T9748-1-3-1-1	Arcadia
50	T9810-4-4-3	T9706-1-3-2-MS	103	T9609-4-1-1-1-1	Aurora X Firefox
51	T9810-4-4-3	T9706-1-6-1-MS	104	T9748-1-3-1-1	Aurora X Firefox
52	T9810-4-4-3	T9735-2-2-2-MS	105	T9748-1-3-1-1	Arcadia X Aurora
53	T9810-4-4-3	T9609-4-1-1-1-1			

Note :

99 = AV 9
98 = AV 10
100 = AV 11
101 = AV 12
102 = AV 13
103 = AV 14
104 = AV 15
105 = AV 16

Appendix 2: Results from field trials

Table 1: General selection Criteria for fresh tomatoes – with desirable ratings shaded.

		Rating				
Criteria		1	2	3	4	5
B	Vine Vigour	Low	Low/Medium	Medium	Medium/Strong	Strong
	Habit	Prostrate	Compact	Upright		
U	Size	Small	Small/Medium	Medium	Medium/Large	Large
	Maturity	Early	Early/Mid	Mid	Mid-late	Late
S	Cover	Sparse	Medium/Spars e	Medium	Medium/Dense	Dense
	Leaf Size	Small	Small Medium	Medium	Medium/Large	Large
H	Leaf Colour	Light	Medium	Dark		
	Leaf Roll	None	Some	Most/All		

F	Shape	Elongated	Globe	Round	Round/Flat	Flat-round
	Size	Small	Small/Medium	Medium	Medium/Large	Large
	Base Colour	Uniform Green	Light GS	Green Shoulder	Striped	
R	Blossom Scar	Small	Small/Medium	Medium	Medium/Large	Large
	Calyx Scar	Small	Small Medium	Medium	Medium/Large	Large
U	Firmness	Soft	Medium	Medium/firm	Firm	Very Firm
	Cracks	None	Radial	Concentric	Both	
I	Ripe Colour (external)	Poor	Medium	Good	Very Good	
	Colour Defects	None	Greywall	Fenceposting		
	Jointedness	Jointless	Jointed	Arthritic		
T						
	Yield	Poor	Medium	Good	Very Good	
	Flavour	Poor	Poor/Medium	Medium	Good	Very Good

SEVERITY OF DEFECTS & DISEASES	0-10 %	10-25 %	25-50 %	50-75 %	75-100 %
Blossom end Rot					
Cat-face					
Splitting					
Big-bud					
Powdery M.					
Bacterial Speck					
Other					
OVERALL SCORE (1-10)	Poor	Good

Table 2: Yield and Quality attributes of ground tomatoes from the replicated trial at Byrneside (Scrimizzi) - 1997/98 Season.

Cultivar	Total Yield (t/ha)	Size Distribution and Unmarketable Fruit (%)				Firmness (mm)	SS (%)	pH	TA (%citric)	Calyx Retention (%)		
		<30 mm	30 to 45 mm	45 to 60 mm	60 to 80 mm >80 mm							
Arcadia	103.4	0.3	4.7	51.1	33.4	0.0	10.5	1.27	6.1	4.04	0.65	75
T8606A	86.1	0.6	5.1	54.5	30.6	0.3	9.0	1.19	7.1	4.02	0.67	88
T9202A	68.6	0.9	8.2	58.8	20.0	0.0	12.1	1.40	7.0	4.09	0.64	86
T9212	44.0	0.6	5.7	38.2	30.3	0.0	25.2	1.45	8.1	4.14	0.55	79
T9215	76.0	0.1	2.4	37.3	47.3	0.7	12.3	1.66	7.0	4.12	0.57	84
T9334	83.1	0.6	2.8	40.2	40.2	1.1	15.1	1.45	6.6	4.08	0.59	83
T9343	55.4	0.9	4.1	49.6	26.8	1.7	16.9	1.46	7.3	4.08	0.66	90
T8601	65.3	1.1	6.9	42.5	39.3	0.7	9.6	1.27	7.0	4.03	0.62	88
T9202B	69.8	0.2	6.6	53.0	30.2	0.3	9.6	1.56	6.8	4.03	0.67	82
Triumph	65.0	0.5	4.5	50.1	27.6	1.0	16.3	1.45	6.8	4.02	0.62	83
Vulcan	64.9	0.2	1.6	28.4	44.3	1.1	24.4	1.88	6.8	4.02	0.53	47
Waratah	78.0	0.4	3.2	47.8	38.2	0.4	10.2	1.19	6.4	3.99	0.64	88
LSD 05	32.0	0.7	3.6	11.9	12.7	1.6	6.8	0.29	0.8	0.07	0.09	12

Note: T8601 = Plots 205 and 206 from 1995/96 season
T8606A = Plots 207 and 208 from 1995/96 season
T8606B = Plots 210, 212 and 215 from 1995/96 season
T9202A = T9202-4-2-1-MS
T9202B = T9202-3-3-3-MSA
T9212 = T9212-2-2-1-MS
T9215 = T9215-3-1-2-MS
T9334 = T9334-4-6-MS
T9343 = T9343-3-2-MS
Vulcan = D713

Table 3: Yield and Quality attributes of ground tomatoes from the replicated trial at Toolamba (Eren) - 1997/98 Season.
 Transplanted: 9/10/1997 Harvested: 19/1, 6/2, & 18/2/1998

Cultivar	Total Yield (t/ha)	Size Distribution and Unmarketable Fruit (%)			Firmness (mm)	SS (%)	PH	TA (%citric)	Calyx Retention (%)			
		<30 mm	30 to 45 mm	45 to 60 mm						60 to 80 mm	>80 mm	Unmark
Arcadia	173.1	0.2	0.9	39.0	51.8	0.5	7.6	1.60	4.3	4.02	0.52	64
T8606A	176.3	0.1	2.0	37.5	49.5	0.7	10.2	1.66	4.7	4.13	0.59	63
T9202A	177.6	0.4	2.3	38.5	47.8	0.7	10.3	1.62	4.6	4.17	0.59	63
T9212	141.7	0.1	0.9	18.8	63.2	6.8	10.2	1.35	4.8	4.24	0.49	54
T9215	161.9	0.1	0.8	18.5	67.7	2.3	10.7	1.63	4.5	4.15	0.50	61
T9334	176.1	0.1	0.7	17.4	69.4	1.1	11.3	1.52	4.5	4.20	0.49	71
T9343	185.4	0.5	1.0	17.5	63.4	4.5	13.6	1.69	4.6	4.19	0.56	67
T8601	164.8	0.2	1.3	32.4	54.7	0.6	10.8	1.59	4.5	4.15	0.56	65
T9202B	194.0	0.2	1.4	37.7	52.3	0.2	8.3	1.71	4.6	4.10	0.57	65
Triumph	194.4	0.1	1.0	23.8	68.0	1.0	6.1	1.61	4.4	4.10	0.57	70
Vulcan	197.9	0.0	0.3	10.9	59.2	12.3	17.3	1.83	4.3	4.19	0.49	33
Waratah	186.0	0.2	0.6	20.4	69.2	2.0	7.7	1.42	4.2	4.07	0.54	70
LSD 05	28.4	0.2	1.0	7.1	8.0	3.4	3.9	0.29	0.3	0.08	0.06	7

Note: T8601 = Plots 205 and 206 from 1995/96 season
 T8606A = Plots 207 and 208 from 1995/96 season
 T8606B = Plots 210, 212 and 215 from 1995/96 season
T9202A = T9202-4-2-1-MS
 T9202B = T9202-3-3-MSA

T9212 = T9212-2-2-1-MS
 T9215 = T9215-3-1-2-MS
 T9334 = T9334-4-6-MS
 T9343 = T9343-3-2-MS
 Vulcan = D713

Table 4: Combined results from replicated fresh tomato ground trials, Season 1998/99

LINE/cv	SIZE DISTRIBUTION (%)						YIELD T/HA	CALYX % RETN	FIRMNESS (mm)	PH	T.Acid (% citric)	SS (%)	Score (/10)
	Med/sm	Medium	M/large	Large	Reject								
Arcadia	1.9	47.5	41.8	0.1	8.8	137	56.8	1.17	3.97	0.56	4.4	6	
Waratah	0.6	31.8	59.8	1.0	6.8	162	70.0	1.13	3.86	0.53	4.5	7	
Triumph	0.6	32.8	58.1	1.1	7.5	159	66.2	1.13	3.89	0.52	4.6	6	
T9202	1.2	33.0	54.7	1.7	9.4	146	69.5	1.26	3.86	0.51	4.9	4.5	
T9204	0.4	21.4	64.7	2.8	10.6	140	58.6	1.39	4.01	0.43	5.0	5.5	
T9215	0.6	24.3	61.0	2.6	11.6	152	64.2	1.32	3.92	0.46	4.7	4	
T9334	0.4	27.2	61.3	1.1	10.2	149	67.1	1.24	3.93	0.48	4.8	6	
T9343A	0.9	23.8	59.1	3.0	13.2	149	69.0	1.35	3.92	0.49	4.7	5.5	
T9343B	0.6	19.9	61.4	4.5	13.7	150	64.6	1.20	3.93	0.48	4.6	7	

Note: Shading indicates those lines not significantly different (P=0.05) from the highest performer for each attribute.

Table 5: Fruit quality data from replicated trellis trial – Lancaster (Mercuri) – Season 1998/99.

Variety	Firmness (mm comp)	PH	Titr. Acid (% citric)	Soluble Solids (%)	SS/Titr Acid	Field Rating
Daniela	1.12	3.9	0.52	5.1	10.1	6
Enya	1.20	4.0	0.54	5.1	9.7	5.5
Abigail	1.01	3.9	0.54	5.2	9.9	6
Mercedes	1.16	3.8	0.53	5.2	9.9	5
Red Bluff	1.52	4.0	0.49	5.4	11.4	5.5
SPS 982	1.12	3.9	0.49	5.3	11.0	4.5

Notes: Shading represents the cultivars not significantly different from the highest performer.
The ratio of Soluble Solids : Titratable Acidity is calculated as an indicator of flavour.

Table 6: Yield and quality of trellis tomatoes from the early planting at Kialla West – 1999/2000 Season.

Variety	Fruit quality									
	Yield Total (t/ha)	No. 1 fruit (t/ha) (65-80 mm)	Unmarketable (%)	Average size (g)	Consistency of size (%CV)	Calyx retention (%)	Firmness (mm)	Sweetness (% SS)	Flavour (SS:TA)	
Gabriela	166	107	11	135	22	51	115	5.0	12.5	
Temptation	155	83	25	132	21	27	102	5.0	10.8	
TA 1147	152	94	11	128	18	39	130	4.8	14.1	
Red Ruby	151	79	7	117	21	39	100	4.6	10.5	
Daniela	150	95	8	135	23	39	107	4.9	11.7	
Petula	148	89	6	135	17	43	98	4.9	9.4	
Citation	136	74	12	130	23	35	106	5.1	11.9	
Atlatico	135	76	12	125	22	46	104	5.1	12.2	
Zorro	133	74	7	133	25	34	111	5.3	11.1	
Redcoat	132	77	6	128	19	41	120	5.0	11.2	
Fascination	125	62	7	122	19	39	142	5.1	11.8	
Mercedes	124	62	9	121	16	44	119	5.0	11.0	
SPS 7495	122	76	5	127	17	45	108	5.0	12.5	
Izabella	113	66	7	119	23	53	100	5.2	11.8	
Abigail	111	71	13	142	20	39	91	5.1	12.6	
LSD_{0.05}	26	19	5	12	6	9	25	0.2	1.6	

Figures in bold and underlined represent the best group of varieties (P=0.05).

Yield of No 1 fruit is the yield of fruit in the 65-80 mm range.

Unmarketable is defined as fruit showing distortion or blemishes caused by pests, diseases, sunshine or rubbing.

Consistency of size is determined by measuring coefficient of variance of fruit size. Larger indicates greater variability.

Firmness is measured by the distortion in the fruit caused by a standard weight. Larger indicates softer.

Sweetness is measured by the soluble solid content. Larger indicates sweeter.

Flavour is calculated as the ratio of soluble solid to titratable acidity. Measurements over 12 indicate better flavour.

Table 7: Yield and quality of trellis tomatoes from the mid-season planting at Kialla West – 1999/2000 Season.

Variety	Yield		Fruit quality						
	Total (t/ha)	No. 1 fruit (t/ha) (60-85 mm)	Unmarketable (%)	Average size (g)	Consistency of size (%CV)	Calyx retention (%)	Firmness (mm)	Sweetness (% SS)	Flavour (SS:TA)
Red Ruby	<u>113</u>	<u>44</u>	<u>8</u>	104	<u>15</u>	42	<u>102</u>	<u>4.7</u>	12.3
Atlatico	<u>112</u>	<u>50</u>	<u>8</u>	<u>110</u>	21	47	126	<u>4.7</u>	13.7
Petula	<u>111</u>	<u>59</u>	<u>9</u>	<u>119</u>	<u>20</u>	41	<u>104</u>	4.5	10.0
SPS 7495	<u>111</u>	<u>58</u>	<u>7</u>	<u>114</u>	<u>20</u>	50	<u>121</u>	<u>4.9</u>	<u>14.2</u>
Izabella	<u>109</u>	<u>54</u>	<u>9</u>	<u>117</u>	21	44	<u>119</u>	4.5	11.6
Zorro	<u>106</u>	<u>59</u>	<u>9</u>	<u>131</u>	25	34	<u>107</u>	<u>5.0</u>	12.7
Gabriela	<u>104</u>	<u>50</u>	11	<u>114</u>	<u>19</u>	46	<u>119</u>	<u>4.8</u>	12.3
Citation	<u>102</u>	<u>52</u>	<u>8</u>	<u>116</u>	<u>20</u>	42	<u>117</u>	<u>4.8</u>	<u>13.9</u>
Daniela	<u>100</u>	<u>51</u>	<u>8</u>	<u>112</u>	24	44	<u>118</u>	4.7	13.4
Mercedes	<u>98</u>	<u>46</u>	<u>9</u>	<u>113</u>	<u>18</u>	53	124	4.6	10.4
TA 1147	<u>98</u>	<u>53</u>	<u>6</u>	<u>118</u>	24	39	<u>110</u>	<u>4.8</u>	<u>15.6</u>
Abigail	<u>92</u>	<u>50</u>	<u>8</u>	<u>118</u>	<u>18</u>	43	<u>109</u>	<u>4.8</u>	12.3
Fascination	90	37	<u>7</u>	105	<u>20</u>	46	130	<u>5.0</u>	13.4
Redcoat	88	41	<u>9</u>	<u>114</u>	<u>20</u>	51	126	<u>4.7</u>	12.2
Temptation	86	41	16	<u>114</u>	<u>19</u>	<u>21</u>	123	<u>4.8</u>	10.3
LSD_{0.05}	21	16	3	10	6	9	20	0.3	1.9

See explanations under Table 6.

Table 8: Yield and quality of trellis tomatoes from the late planting at Kialla West – 1999/2000 Season.

Variety	Yield		Fruit quality					Sweetness (% SS)	Firmness (mm)	Calyx retention (%)	Consistency of size (%CV)	Flavour (SS:TA)
	Total (t/ha)	No. 1 fruit (t/ha)	Unmarketable (%)	Average size (g)	Consistency of size (%CV)	Firmness (mm)	Sweetness (% SS)					
Atlatico	<u>71</u>	<u>40</u>	<u>13</u>	123	<u>5</u>	125	4.9	10.2				
Red Ruby	<u>65</u>	<u>34</u>	<u>10</u>	111	<u>10</u>	<u>86</u>	4.7	9.7				
Citation	<u>64</u>	<u>34</u>	<u>10</u>	124	<u>10</u>	<u>106</u>	4.9	<u>11.3</u>				
Daniela	<u>62</u>	<u>42</u>	<u>9</u>	<u>135</u>	<u>10</u>	<u>106</u>	4.8	9.7				
Zorro	<u>60</u>	<u>34</u>	<u>11</u>	<u>139</u>	24	114	<u>5.3</u>	<u>11.0</u>				
TA 1147	<u>58</u>	<u>39</u>	<u>10</u>	<u>131</u>	<u>13</u>	<u>92</u>	4.6	<u>11.1</u>				
Petula	<u>57</u>	<u>33</u>	<u>11</u>	124	<u>11</u>	118	4.9	8.5				
Abigail	<u>55</u>	<u>36</u>	<u>14</u>	<u>134</u>	<u>10</u>	<u>99</u>	<u>5.2</u>	10.2				
Gabriela	<u>53</u>	<u>35</u>	<u>13</u>	<u>135</u>	<u>9</u>	<u>103</u>	4.8	10.4				
Mercedes	<u>52</u>	28	<u>11</u>	119	<u>14</u>	<u>101</u>	<u>5.1</u>	10.1				
Redcoat	47	24	<u>12</u>	116	18	123	4.9	10.0				
SPS 7495	47	24	15	116	<u>8</u>	<u>103</u>	4.9	10.4				
Fascination	45	20	<u>12</u>	110	<u>15</u>	118	5.0	10.1				
Izabella	45	27	<u>10</u>	121	<u>14</u>	<u>110</u>	<u>5.4</u>	<u>10.8</u>				
Temptation	45	21	19	117	17	114	<u>5.3</u>	8.8				
LSD_{0.05}	15	11	5	13	10	28	0.3	0.7				

See explanations under Table 6.

Table 9: Overall yield and quality of trellis tomatoes from Kialla West trials: 1999/2000.

Variety	Fruit quality									
	Yield (t/ha)	Total (t/ha)	No. 1 fruit (t/ha)	Unmarketable (%)	Average size (g)	consistency of size (%CV)	Calyx retention (%)	Firmness (mm)	Sweetness (% SS)	Flavour (SS:TA)
Red Ruby	<u>109</u>	52	<u>8</u>	111	<u>15</u>	41	<u>96</u>	4.6	10.8	
Gabriela	<u>108</u>	<u>64</u>	12	<u>128</u>	<u>17</u>	49	112	4.8	11.7	
Atlatico	<u>106</u>	<u>55</u>	<u>11</u>	119	<u>16</u>	48	118	4.9	12.0	
Petula	<u>105</u>	<u>60</u>	<u>9</u>	126	<u>16</u>	43	<u>106</u>	4.7	9.3	
Daniela	<u>104</u>	<u>62</u>	<u>8</u>	<u>127</u>	<u>19</u>	43	<u>110</u>	4.8	11.6	
TA 1147	<u>102</u>	<u>62</u>	<u>9</u>	126	<u>18</u>	40	111	4.7	<u>13.6</u>	
Citation	<u>101</u>	53	<u>10</u>	123	<u>17</u>	41	<u>110</u>	4.9	12.3	
Zorro	<u>100</u>	<u>56</u>	<u>9</u>	<u>134</u>	25	35	111	<u>5.2</u>	11.6	
Temptation	95	49	20	121	<u>19</u>	<u>22</u>	113	<u>5.0</u>	9.9	
SPS 7495	93	52	<u>9</u>	119	<u>15</u>	50	110	4.9	12.4	
Mercedes	91	45	<u>10</u>	118	<u>16</u>	49	114	4.9	10.5	
Izabella	89	49	<u>8</u>	119	<u>19</u>	51	<u>109</u>	<u>5.0</u>	11.4	
Redcoat	89	47	<u>9</u>	120	<u>19</u>	46	123	4.9	11.1	
Fascination	87	40	<u>9</u>	112	<u>18</u>	44	130	<u>5.0</u>	11.8	
Abigail	86	52	12	<u>131</u>	<u>16</u>	41	<u>100</u>	<u>5.0</u>	11.7	
LSD_{0.05}	13	10	3	7	4	6	14	0.2	0.9	

See explanations under Table 6.

Table 10: Fresh market hybrid tomato evaluation 2000-2001.

Variety	Source	Yield		Size Distribution and Unmarketable Fruit (%)							Calyx Retention (%)	Firmness (mm)	SS (%)	pH	TA (%citric)	ss/TA
		(t/ha)	%	%	%	%	%	%	%	%						
			small	small-medium	medium	medium-large	large	unmarketable								
AV7	Ag Vic	104.8	32.2	11.4	32.4	14.4	3	6.6	48	106	4.8	4.52	0.48	10.2		
AV6	Ag Vic	101.8	20.5	7.3	33.3	24.3	8.4	6.4	61	98	4.6	4.58	0.45	10.1		
AV5	Ag Vic	101.8	36.3	13.5	35.1	8.6	1.3	5.3	58	115	4.4	4.52	0.52	8.5		
AV2	Ag Vic	95.2	31.1	12.1	36.4	13	1.3	6.3	68	114	4.5	4.47	0.52	8.7		
Rebel	SPS	94.2	28.9	20.1	30	13.2	2	6.2	53	123	4.6	4.46	0.51	9.1		
AV1	Ag Vic	93.9	51.7	16.2	28.1	2.9	0	1.3	61	118	4.3	4.45	0.53	8.1		
Arcadia	Ag Vic	87.3	53.3	11.9	24.5	5.2	0.2	4.9	58	117	4.2	4.45	0.45	9.6		
AV8	Ag Vic	87	33.2	11.9	33.9	15.9	0.9	4.3	59	108	4.7	4.49	0.49	9.7		
AV3	Ag Vic	85.5	35.9	24.1	22.9	10.3	2.2	4.6	53	112	4.8	4.51	0.63	8.1		
AV4	Ag Vic	84.9	35	18.8	23.5	15.9	1.4	5.4	71	108	4.8	4.5	0.5	9.7		

Table 11: Comparison between promising ground hybrid tomato AV6 and commercial standard cv Rebel from replicated field trials at three commercial sites in season 2001/02.

Variety	Yield (t/ha)	Fruit grade distribution (%)			Fruit size (g)	Fruit height:width	Firmness (mm)	SS (%)	SS:TA	Colour (a/b)
		Small	Small-med	Large-med						
AV6	124.7	7.5	21.0	65.3	128	1.29	5.1	8.9	2.10	
Rebel	110.7	11.5	25.9	59.9	115	1.11	5.1	7.3	2.09	
P	0.35	0.40	0.002	0.11	0.002	0.23	0.91	<0.001	0.28	

Table 12. Summarised results of a replicated trial at DPI Tatura, season 2002/3, to evaluate promising determinate tomato hybrids*

Hybrid	Yield (t/ha)	Fruit grade distribution (%)			Large	Fruit height:width	Firmness (mm)	SS (%)	SS:TA	Colour
		Small	Small-med	Large-med						
AV12	83.7	0.5	25.2	73.4	0.4	0.825	4.00	8.27	2.04	
AV15	83.5	0.2	22.2	77.7	0	0.771	4.35	8.83	2.05	
AV10	83.3	0.1	27.3	72.5	0	0.732	4.43	7.23	1.81	
AV11	82.6	0.3	28.9	70.4	0.4	0.837	4.18	8.12	2.01	
AV9	82.5	0.2	23.4	72.4	0	0.818	4.40	9.56	1.86	
AV14	82.4	0.2	27.6	72.2	0	0.762	4.43	8.92	1.94	
AV6	81.1	0.1	27.2	71.8	0.9	0.799	4.70	10.59	1.98	
AV13	81.0	0.3	23.8	74.8	1.4	0.821	4.40	8.80	1.89	
AV16	75.8	0.3	21.6	78.1	0	0.767	4.05	7.96	2.24	
LSD _{0.05}	15.3	0.4	6.4	6.6	1.1	0.056	0.34	1.72	0.58	

*Shaded figures represent the best statistical sub-set ($P=0.05$).

Appendix 3: Final Breeding line descriptions

Selection	9804-1-3-1-1	9804-1-3-4-1	9804-1-3-6-1	9810-4-1-1-1	9810-4-1-1-2
Generation	F ₆	F ₆	F ₆	F ₆	F ₆
Maternal	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	Daniela	Daniela
Paternal	Daniela	Daniela	Daniela	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics					
Vigour	Medium	Medium	Medium	Medium-strong	Medium
Habit	Compact	Compact	Compact	Compact-upright	Compact-upright
Maturity	Mid	Mid-late	Mid	Early-mid	Mid
Cover	Medium	Medium-sparse	Medium	Medium-dense	Medium
Leaf Size	Medium	Medium	Small-medium	Medium	Medium
Leaf Colour	Light	Light	Light	Light	Light
Leaf Roll	No	No	Some	No	No
Yield	Medium	Medium	Medium	Very good	Good
Fruit Characteristics					
Shape	Flat-round	Flat-round	Round-flat	Flat-round	Flat-round
Size	Medium	Medium	Medium-large	Small-medium	Medium
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Small	Small	Small	Small-medium	Small-medium
Calyx Scar	Medium	Medium-large	Medium-large	Medium	Medium-large
Firmness	Medium-firm	Medium	Very firm	Firm	Very firm
Cracks	No	Concentric	Radial	No	No
External Colour	Very good	Very good	Good	Very good	Good
Internal Colour	Good	Very good	Good	Very good	Very good
Colour Defects	No	No	No	No	No
Pedice	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Poor-medium	Good	Very good	Medium	Poor-medium

Selection	9810-4-1-6-1	9810-4-1-7-1	9810-4-1-8-1	9810-4-1-9-1	9810-4-1-9-2
Generation	F ₆	F ₆	F ₆	F ₆	F ₆
Maternal	Daniela	Daniela	Daniela	Daniela	Daniela
Paternal	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics					
Vigour	Low-medium	Medium	Strong	Medium	Medium
Habit	Compact-upright	Compact-upright	Compact	Compact-upright	Compact-upright
Maturity	Early-mid	Early-mid	Mid	Early-mid	Mid
Cover	Medium-sparse	Medium	Medium	Medium	Medium
Leaf Size	Medium	Medium	Medium	Medium	Medium
Leaf Colour	Light	Mid	Mid	Mid	Mid
Leaf Roll	No	No	No	No	No
Yield	Very good	Very good	Very good	Very good	Good
Fruit Characteristics					
Shape	Flat-round	Flat-round	Flat-round	Flat-round	Flat-round
Size	Medium	Medium	Medium	Medium-large	Medium-large
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Small-medium	Small-medium	Medium	Small-medium	Medium
Calyx Scar	Medium	Medium	Medium-large	Medium	Medium-large
Firmness	Firm	Very firm	Very firm	Very firm	Medium-firm
Cracks	No	No	No	No	No
External Colour	Good	Good	Very good	Good	Very good
Internal Colour	Very good	Very good	Very good	Very good	Very good
Colour Defects	No	No	No	No	No
Pedice	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Medium	Medium	Good	Good	Very good

Selection	9810-4-1-9-3	9810-4-1-10-1	9810-4-1-10-2	9810-4-1-10-3	9810-4-1-10-4
Generation	F ₆	F ₆	F ₆	F ₆	F ₆
Maternal	Daniela	Daniela	Daniela	Daniela	Daniela
Paternal	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics					
Vigour	Medium	Medium-strong	Medium	Medium	Medium
Habit	Compact-upright	Compact-upright	Compact-upright	Compact-upright	Compact-upright
Maturity	Mid	Mid	Early-mid	Early-mid	Early
Cover	Medium	Medium-dense	Medium	Medium	Medium
Leaf Size	Medium	Medium	Medium	Medium	Medium
Leaf Colour	Mid	Mid	Mid	Mid	Mid
Leaf Roll	No	No	No	No	No
Yield	Medium	Very good	Very good	Good	Very good
Fruit Characteristics					
Shape	Flat-round	Flat-round	Flat-round	Flat-round	Flat-round
Size	Medium-large	Medium	Medium-large	Medium	Medium
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Small-medium	Small-medium	Small-medium	Small-medium	Medium
Calyx Scar	Medium	Medium-large	Medium-large	Medium	Medium
Firmness	Very firm	Very firm	Medium-firm	Medium-firm	Very firm
Cracks	No	No	No	No	No
External Colour	Poor	Very good	Very good	Very good	Good
Internal Colour	Medium	Very good	Very good	Very good	Very good
Colour Defects	No	No	No	No	No
Pedicel	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Poor-medium	Good	Very good	Good	Very good

Selection	9810-4-1-10-5	9810-4-1-11-1	9810-4-1-11-2	9810-4-2-1-1	9810-4-2-1-2
Generation	F ₆	F ₆	F ₆	F ₆	F ₆
Maternal	Daniela	Daniela	Daniela	Daniela	Daniela
Paternal	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics					
Vigour	Low-medium	Medium-strong	Medium-strong	Medium	Medium
Habit	Compact-upright	Compact-upright	Compact-upright	Compact-upright	Compact-upright
Maturity	Early-mid	Early-mid	Early-mid	Early	Mid
Cover	Medium-sparse	Medium	Medium	Medium-sparse	Medium
Leaf Size	Medium-large	Medium	Medium	Medium	Medium
Leaf Colour	Mid	Light	Light	Mid	Mid
Leaf Roll	No	No	No	No	No
Yield	Very good	Good	Good	Very good	Good
Fruit Characteristics					
Shape	Flat-round	Flat-round	Flat-round	Flat-round	Flat-round
Size	Medium	Medium	Small-medium	Medium	Medium-large
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Small-medium	Small-medium	Small	Small-medium	Medium
Calyx Scar	Medium-large	Medium-large	Medium-large	Medium-large	Medium-large
Firmness	Very firm	Very firm	Firm	Medium-firm	Medium-firm
Cracks	No	No	No	No	No
External Colour	Good	Good	Good	Good	Very good
Internal Colour	Good	Good	Good	Good	Very good
Colour Defects	No	No	No	No	No
Pedicel	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Very good	Good	Good	Good	Medium

Selection	9810-4-2-3-1	9810-4-2-3-2	9810-4-2-4-1	9810-4-2-4-2	9810-4-2-4-3
Generation	F ₆	F ₆	F ₆	F ₆	F ₆
Maternal	Daniela	Daniela	Daniela	Daniela	Daniela
Paternal	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics					
Vigour	Medium-strong	Medium-strong	Medium-strong	Medium-strong	Medium
Habit	Compact-upright	Compact-upright	Compact-upright	Compact-upright	Upright
Maturity	Mid	Mid	Early-mid	Early-mid	Mid
Cover	Medium	Medium-dense	Medium	Medium	Medium-sparse
Leaf Size	Medium	Medium	Medium	Medium	Medium
Leaf Colour	Mid	Mid	Mid	Mid	Mid
Leaf Roll	No	No	No	No	No
Yield	Very good	Very good	Very good	Good	Good
Fruit Characteristics					
Shape	Flat-round	Flat-round	Flat-round	Flat-round	Flat-round
Size	Medium-large	Medium-large	Medium	Medium-large	Small-medium
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Small-medium	Small-medium	Medium	Small-medium	Small-medium
Calyx Scar	Medium-large	Medium	Medium	Medium	Medium-large
Firmness	Medium-firm	Very firm	Medium	Very firm	Medium
Cracks	No	No	No	No	No
External Colour	Poor	Good	Very good	Very good	Good
Internal Colour	Medium	Medium	Medium	Medium	Medium
Colour Defects	No	No	No	No	No
Pedicel	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Medium	Poor-medium	Medium	Medium	Medium

Selection	9810-4-2-4-4	9810-4-2-4-5	9810-4-2-5-1	9810-4-2-6-1	9810-4-2-6-2
Generation	F ₆	F ₆	F ₆	F ₆	F ₆
Maternal	Daniela	Daniela	Daniela	Daniela	Daniela
Paternal	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics					
Vigour	Medium	Medium-strong	Medium	Medium	Medium
Habit	Compact-upright	Compact-upright	Compact-upright	Compact-upright	Compact-upright
Maturity	Mid-late	Early-mid	Mid	Mid	Mid
Cover	Medium-sparse	Medium	Medium	Medium	Medium
Leaf Size	Medium	Medium	Medium	Medium	Medium
Leaf Colour	Mid	Mid	Mid	Mid	Mid
Leaf Roll	No	No	No	No	No
Yield	Good	Very good	Very good	Good	Good
Fruit Characteristics					
Shape	Flat-round	Flat-round	Flat-round	Round-flat	Round-flat
Size	Medium	Medium-large	Medium-large	Small-medium	Medium
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Medium	Medium	Small-medium	Small-medium	Medium-large
Calyx Scar	Medium	Medium-large	Medium-large	Medium	Medium-large
Firmness	Medium-firm	Medium-firm	Medium-firm	Very firm	Medium-firm
Cracks	No	No	No	No	No
External Colour	Good	Very good	Very good	Very good	Very good
Internal Colour	Good	Good	Good	Good	Good
Colour Defects	No	No	No	No	No
Pedicel	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Medium	Medium	Good	Good	Good

Selection	9810-4-2-6-3	9810-4-2-6-4	9810-4-2-6-5	9810-4-2-8-1	9810-4-2-8-2
Generation	F ₆	F ₆	F ₆	F ₆	F ₆
Maternal	Daniela	Daniela	Daniela	Daniela	Daniela
Paternal	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics					
Vigour	Medium	Medium-strong	Medium	Medium-strong	Medium
Habit	Compact-upright	Compact-upright	Compact-upright	Compact-upright	Compact-upright
Maturity	Early-mid	Early-mid	Early-mid	Early-mid	Mid
Cover	Medium	Medium	Medium-dense	Medium-dense	Medium
Leaf Size	Medium	Medium	Medium	Medium	Medium
Leaf Colour	Mid	Mid	Mid	Mid	Mid
Leaf Roll	Some	No	No	No	No
Yield	Very good	Very good	Very good	Very good	Medium
Fruit Characteristics					
Shape	Flat-round	Flat-round	Flat-round	Flat-round	Flat-round
Size	Medium-large	Medium-large	Large	Medium	Medium-large
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Medium	Medium	Small	Small-medium	Small-medium
Calyx Scar	Medium-large	Medium-large	Medium-large	Medium	Medium-large
Firmness	Very firm	Firm	Medium-firm	Medium	Very firm
Cracks	No	Radial	No	No	Radial
External Colour	Very good	Good	Good	Very good	Very good
Internal Colour	Very good	Good	Medium	Very good	Very good
Colour Defects	No	No	No	No	No
Pedicel	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Medium	Medium	Medium	Medium	Good

Selection	9810-4-3-1-1	9810-4-3-2-1	9810-4-3-2-2	9810-4-3-3-1	9810-4-3-4-1
Generation	F ₆	F ₆	F ₆	F ₆	F ₆
Maternal	Daniela	Daniela	Daniela	Daniela	Daniela
Paternal	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics					
Vigour	Medium	Medium-strong	Medium-strong	Medium-strong	Medium
Habit	Compact-upright	Compact-upright	Compact-upright	Compact-upright	Compact-upright
Maturity	Mid	Early-mid	Early-mid	Early-mid	Early-mid
Cover	Medium	Medium	Medium	Medium-dense	Medium
Leaf Size	Medium	Medium	Medium	Medium	Medium
Leaf Colour	Mid	Mid	Mid	Mid	Mid
Leaf Roll	No	No	No	No	No
Yield	Good	Good	Very good	Very good	Very good
Fruit Characteristics					
Shape	Flat-round	Flat-round	Flat-round	Flat-round	Flat-round
Size	Medium	Medium	Medium	Medium	Medium
Base Colour	Uniform	Green shoulder	Uniform	Uniform	Uniform
Blossom Scar	Small-medium	Small-medium	Small-medium	Small-medium	Small-medium
Calyx Scar	Medium-large	Medium	Medium	Medium	Medium-large
Firmness	Firm	Very firm	Very firm	Medium-firm	Firm
Cracks	No	No	No	No	No
External Colour	Very good	Medium	Good	Very good	Good
Internal Colour	Very good	Good	Medium	Good	Good
Colour Defects	No	No	No	No	No
Pedicel	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Good	Poor-medium	Medium	Poor-medium	Medium

Selection	9810-4-3-4-2	9810-4-6-1-1	9810-4-9-5-1	0203-1	0203-2
Generation	F ₆	F ₆	F ₆	F ₃	F ₃
Maternal	Daniela	Daniela	Daniela	2XSW5-3XK-9-3	2XSW5-3XK-9-3
Paternal	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	C33XArcadia	C33XArcadia
Bush Characteristics					
Vigour	Medium	Medium	Medium	Medium-strong	Medium-strong
Habit	Compact-upright	Compact-upright	Compact-upright	Compact-upright	Compact-upright
Maturity	Early-mid	Early-mid	Early-mid	Mid	Mid
Cover	Medium	Medium-sparse	Medium-sparse	Medium-dense	Medium-dense
Leaf Size	Medium	Medium	Medium	Medium	Medium
Leaf Colour	Mid	Mid	Mid	Dark	Dark
Leaf Roll	No	No	No	No	No
Yield	Very good	Good	Good	Medium	Medium
Fruit Characteristics					
Shape	Flat-round	Flat-round	Flat-round	Round	Round
Size	Medium-large	Medium	Medium	Medium	Medium
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Small-medium	Small-medium	Medium	Small-medium	Medium
Calyx Scar	Medium-large	Medium-large	Medium-large	Medium-large	Small-medium
Firmness	Very firm	Medium-firm	Medium-firm	Firm	Firm
Cracks	No	Radial	No	No	No
External Colour	Very good	Very good	Very good	Good	Good
Internal Colour	Very good	Very good	Very good	Good	Medium
Colour Defects	No	No	No	No	No
Pedice	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Good	Poor-medium	Poor-medium	Medium	Medium

Selection	0203-3	0203-4	0203-5	0203-6	0204-1
Generation	F ₃	F ₃	F ₃	F ₃	F ₃
Maternal	2XSW5-3XK-9-3	2XSW5-3XK-9-3	2XSW5-3XK-9-3	2XSW5-3XK-9-3	2XSW5-3XK-9-3
Paternal	C33XArcadia	C33XArcadia	C33XArcadia	C33XArcadia	TristarXAurora
Bush Characteristics					
Vigour	Medium-strong	Medium-strong	Medium-strong	Medium-strong	Medium-strong
Habit	Compact-upright	Compact-upright	Compact-upright	Compact-upright	Compact
Maturity	Mid	Early-mid	Mid	Mid	Mid
Cover	Medium-dense	Medium-dense	Medium	Medium-dense	Medium
Leaf Size	Medium	Medium	Medium-large	Medium-large	Medium
Leaf Colour	Dark	Dark	Dark	Dark	Dark
Leaf Roll	No	No	No	No	No
Yield	Medium	Medium	Medium	Medium	Medium
Fruit Characteristics					
Shape	Round	Round-flat	Round-flat	Globe	Round
Size	Medium	Medium-large	Medium	Medium-large	Medium-large
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Medium	Large	Medium-large	Medium-large	Medium-large
Calyx Scar	Small-medium	Medium	Medium	Small-medium	Medium-large
Firmness	Medium-firm	Firm	Firm	Firm	Firm
Cracks	No	No	No	No	No
External Colour	Good	Good	Good	Very Good	Good
Internal Colour	Good	Medium	Medium	Medium	Medium
Colour Defects	No	No	No	No	No
Pedice	Jointless	Jointed	Jointed	Jointless	Jointed
Flavour	Medium	Medium	Medium	Medium	Medium

Selection	0205-1	0207-1	0207-2
Generation	F ₃	F ₃	F ₃
Maternal	2XSW5-3XK-9-3	2XSW5-3XK-9-3	2XSW5-3XK-9-3
Paternal	AuroraXFirefox	AuroraX(FloradadeXArcadia)	AuroraX(FloradadeXArcadia)
Bush Characteristics			
Vigour	Medium-strong	Medium-strong	Medium-strong
Habit	Compact-upright	Compact	Compact
Maturity	Mid	Mid	Mid
Cover	Medium-dense	Medium	Medium-sparse
Leaf Size	Medium-large	Medium-large	Medium
Leaf Colour	Dark	Dark	Dark
Leaf Roll	No	No	No
Yield	Good	Good	Good
Fruit Characteristics			
Shape	Round	Globe	Globe
Size	Medium	Small-medium	Medium
Base Colour	Uniform	Uniform	Uniform
Blossom Scar	Medium	Small	Small
Calyx Scar	Medium	Small-medium	Medium
Firmness	Firm	Firm	Firm
Cracks	No	No	No
External Colour	Good	Good	Good
Internal Colour	Medium	Medium	Medium
Colour Defects	No	No	No
Pedicle	Jointed	Jointless	Jointed
Flavour	Good	Medium	Poor-medium

Selection	0207-3	0208-1	0208-2	0208-3
Generation	F ₃	F ₃	F ₃	F ₃
Maternal	2XSW5-3XK-9-3	2XSW5-3XK-9-3	2XSW5-3XK-9-3	2XSW5-3XK-9-3
Paternal	AuroraX(FloradadeXArcadia)	Arcadia	Arcadia	Arcadia
Bush Characteristics				
Vigour	Medium	Medium	Medium-strong	Medium-strong
Habit	Compact	Compact	Compact	Compact-upright
Maturity	Mid	Early-mid	Mid	Mid
Cover	Medium	Medium	Medium-dense	Medium-dense
Leaf Size	Medium	Medium-large	Medium	Medium
Leaf Colour	Dark	Dark	Dark	Dark
Leaf Roll	No	No	No	No
Yield	Good	Medium	Good	Good
Fruit Characteristics				
Shape	Globe	Flat-round	Elongated	Globe
Size	Medium	Small-medium	Medium	Small-medium
Base Colour	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Small-medium	Large	Small	Large
Calyx Scar	Medium	Small	Small-medium	Medium
Firmness	Firm	Firm	Medium-firm	Very firm
Cracks	No	No	No	No
External Colour	Good	Good	Good	Good
Internal Colour	Medium	Very good	Medium	Good
Colour Defects	No	No	No	No
Pedicle	Jointed	Jointed	Jointed	Jointed
Flavour	Medium	Good	Medium	Medium

Selection	0211-1	0211-2	0211-3
Generation	F ₃	F ₃	F ₃
Maternal	(AuroraXOntario7710)Xaurora	(AuroraXOntario7710)Xaurora	(AuroraXOntario7710)Xaurora
Paternal	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics			
Vigour	Medium-strong	Medium-strong	Medium-strong
Habit	Compact	Compact	Compact
Maturity	Mid	Early-mid	Early-mid
Cover	Medium-dense	Medium	Medium
Leaf Size	Medium	Medium	Medium
Leaf Colour	Mid	Mid	Mid
Leaf Roll	No	No	No
Yield	Good	Good	Good
Fruit Characteristics			
Shape	Round	Round-flat	Round-flat
Size	Medium	Medium	Medium-large
Base Colour	Uniform	Uniform	Uniform
Blossom Scar	Small-medium	Medium-large	Medium-large
Calyx Scar	Small-medium	Small-medium	Small-medium
Firmness	Firm	Firm	Firm
Cracks	No	No	No
External Colour	Good	Good	Good
Internal Colour	Good	Medium	Good
Colour Defects	No	No	No
Pedice	Jointed	Jointed	Jointed
Flavour	Medium	Poor-medium	Medium

Selection	0211-4	0211-5	0211-6
Generation	F ₃	F ₃	F ₃
Maternal	(AuroraXOntario7710)Xaurora	(AuroraXOntario7710)Xaurora	(AuroraXOntario7710)Xaurora
Paternal	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics			
Vigour	Medium-strong	Medium	Medium-strong
Habit	Compact	Compact	Compact
Maturity	Early-mid	Early-mid	Early-mid
Cover	Medium-dense	Medium	Medium
Leaf Size	Medium	Medium	Medium
Leaf Colour	Mid	Mid	Mid
Leaf Roll	No	No	No
Yield	Good	Good	Good
Fruit Characteristics			
Shape	Round	Round	Round-flat
Size	Medium	Medium	Medium
Base Colour	Uniform	Uniform	Uniform
Blossom Scar	Medium	Medium	Medium
Calyx Scar	Small	Small	Small-medium
Firmness	Firm	Firm	Firm
Cracks	No	No	No
External Colour	Good	Medium	Good
Internal Colour	Medium	Medium	Medium
Colour Defects	No	No	No
Pedice	Jointed	Jointed	Jointed
Flavour	Medium	Medium	Medium

Selection	0212-1	0212-2
Generation	F ₃	F ₃
Maternal	(C33XArcadia)X((FloradaeXArcadia)XOntario7710)	(C33XArcadia)X((FloradaeXArcadia)XOntario7710)
Paternal	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics		
Vigour	Medium-strong	Medium-strong
Habit	Compact	Compact
Maturity	Early-mid	Mid
Cover	Medium-dense	Medium
Leaf Size	Medium	Medium
Leaf Colour	Mid	Mid
Leaf Roll	No	No
Yield	Good	Good
Fruit Characteristics		
Shape	Round	Round
Size	Small-medium	Medium
Base Colour	Uniform	Uniform
Blossom Scar	Small-medium	Small-medium
Calyx Scar	Small-medium	Medium
Firmness	Firm	Firm
Cracks	No	No
External Colour	Good	Good
Internal Colour	Good	Medium
Colour Defects	No	No
Pedicel	Jointed	Jointed
Flavour	Poor-medium	Medium

Selection	0212-3	0212-4
Generation	F ₃	F ₃
Maternal	(C33XArcadia)X((FloradaeXArcadia)XOntario7710)	(C33XArcadia)X((FloradaeXArcadia)XOntario7710)
Paternal	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics		
Vigour	Medium-strong	Medium-strong
Habit	Compact	Compact-upright
Maturity	Early-mid	Early-mid
Cover	Medium-dense	Medium
Leaf Size	Medium	Medium
Leaf Colour	Mid	Mid
Leaf Roll	No	No
Yield	Good	Medium
Fruit Characteristics		
Shape	Round	Round
Size	Medium	Small-medium
Base Colour	Uniform	Uniform
Blossom Scar	Medium-large	Small-medium
Calyx Scar	Small-medium	Small-medium
Firmness	Firm	Firm
Cracks	No	No
External Colour	Medium	Good
Internal Colour	Good	Medium
Colour Defects	No	No
Pedicel	Jointed	Jointed
Flavour	Medium	Poor

Selection	0212-5	0212-6
Generation	F ₃	F ₃
Maternal	(C33XArcadia)X((FloradaeXArcadia)XOntario7710)	(C33XArcadia)X((FloradaeXArcadia)XOntario7710)
Paternal	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics		
Vigour	Medium	Medium-strong
Habit	Compact-upright	Compact
Maturity	Early-mid	Mid
Cover	Medium	Medium
Leaf Size	Medium	Medium
Leaf Colour	Mid	Mid
Leaf Roll	No	No
Yield	Medium	Medium
Fruit Characteristics		
Shape	Round	Round
Size	Medium	Medium
Base Colour	Uniform	Uniform
Blossom Scar	Medium	Medium-large
Calyx Scar	Small-medium	Small-medium
Firmness	Firm	Firm
Cracks	No	No
External Colour	Good	Good
Internal Colour	Medium	Medium
Colour Defects	No	No
Pedicel	Jointed	Jointed
Flavour	Poor	Medium

Selection	0212-7	0212-8
Generation	F ₃	F ₃
Maternal	(C33XArcadia)X((FloradaeXArcadia)XOntario7710)	(C33XArcadia)X((FloradaeXArcadia)XOntario7710)
Paternal	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics		
Vigour	Medium-strong	Medium-strong
Habit	Compact-upright	Compact-upright
Maturity	Early-mid	Early-mid
Cover	Medium	Medium
Leaf Size	Medium	Medium
Leaf Colour	Mid	Mid
Leaf Roll	No	No
Yield	Good	Good
Fruit Characteristics		
Shape	Round	Round-flat
Size	Medium	Small-medium
Base Colour	Uniform	Uniform
Blossom Scar	Small-medium	Small
Calyx Scar	Small-medium	Medium
Firmness	Firm	Firm
Cracks	No	No
External Colour	Good	Good
Internal Colour	Medium	Good
Colour Defects	No	No
Pedicel	Jointed	Jointed
Flavour	Poor-medium	Poor

Selection	0212-9	0212-10
Generation	F ₃	F ₃
Maternal	(C33XArcadia)X((FloradaeXArcadia)XOntario7710)	(C33XArcadia)X((FloradaeXArcadia)XOntario7710)
Paternal	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics		
Vigour	Medium-strong	Medium-strong
Habit	Compact	Compact-upright
Maturity	Early-mid	Mid
Cover	Medium	Medium
Leaf Size	Medium	Medium
Leaf Colour	Mid	Mid
Leaf Roll	No	No
Yield	Medium	Medium
Fruit Characteristics		
Shape	Round	Round
Size	Medium-large	Medium
Base Colour	Uniform	Uniform
Blossom Scar	Medium	Small-medium
Calyx Scar	Small-medium	Small
Firmness	Firm	Firm
Cracks	No	No
External Colour	Good	Medium
Internal Colour	Medium	Medium
Colour Defects	No	No
Pedicel	Jointed	Jointed
Flavour	Poor-medium	Medium

Selection	0212-11	0214-1	0214-2
Generation	F ₃	F ₃	F ₃
Maternal	(C33XArcadia)X((FloradaeXArcadia)XOntario7710)	(AuroraXOntario7710)XAurora	(AuroraXOntario7710)XAurora
Paternal	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics			
Vigour	Medium-strong	Medium	Medium-strong
Habit	Compact	Compact-upright	Compact-upright
Maturity	Early-mid	Early-mid	Early-mid
Cover	Medium	Medium	Medium
Leaf Size	Medium	Medium	Medium
Leaf Colour	Mid	Mid	Mid
Leaf Roll	No	No	No
Yield	Good	Medium	Medium
Fruit Characteristics			
Shape	Round	Round-flat	Round
Size	Medium	Small-medium	Medium
Base Colour	Uniform	Uniform	Uniform
Blossom Scar	Small	Medium	Small-medium
Calyx Scar	Small-medium	Medium	Medium
Firmness	Medium-firm	Very firm	Firm
Cracks	No	No	No
External Colour	Good	Good	Good
Internal Colour	Medium	Good	Medium
Colour Defects	No	No	No
Pedicel	Jointed	Jointed	Jointed
Flavour	Medium	Medium	Medium

Selection	0214-3	0214-4	0217-1
Generation	F ₃	F ₃	F ₃
Maternal	(AuroraXOntario7710)Xaurora	(AuroraXOntario7710)Xaurora	2XSW5-3XK-9-3
Paternal	ArcadiaXAurora	ArcadiaXAurora	AuroraXFirefox
Bush Characteristics			
Vigour	Medium-strong	Medium-strong	Medium
Habit	Compact-upright	Compact-upright	Compact
Maturity	Early-mid	Early-mid	Mid
Cover	Medium	Medium	Medium
Leaf Size	Medium	Medium	Medium
Leaf Colour	Mid	Light	Dark
Leaf Roll	No	No	No
Yield	Medium	Good	Medium
Fruit Characteristics			
Shape	Globe	Round-flat	Round-flat
Size	Medium-large	Medium-large	Medium-large
Base Colour	Uniform	Uniform	Uniform
Blossom Scar	Medium	Medium-large	Medium
Calyx Scar	Small-medium	Small-medium	Medium-large
Firmness	Very firm	Firm	Firm
Cracks	No	No	No
External Colour	Medium	Good	Good
Internal Colour	Medium	Medium	Medium
Colour Defects	No	No	No
Pedice	Jointed	Jointed	Jointed
Flavour	Poor-medium	Poor	Medium

Selection	0219-1	0219-2
Generation	F ₃	F ₃
Maternal	(C33XArcadia)X((FloradadeXArcadia)XOntario7710)	(C33XArcadia)X((FloradadeXArcadia)XOntario7710)
Paternal	AuroraXFirefox	AuroraXFirefox
Bush Characteristics		
Vigour	Medium	Medium
Habit	Compact-upright	Compact-upright
Maturity	Mid	Mid
Cover	Medium	Medium
Leaf Size	Medium	Medium
Leaf Colour	Mid	Mid
Leaf Roll	No	No
Yield	Medium	Medium
Fruit Characteristics		
Shape	Round	Round
Size	Medium-large	Medium-large
Base Colour	Uniform	Uniform
Blossom Scar	Medium	Medium-large
Calyx Scar	Small-medium	Medium
Firmness	Firm	Medium-firm
Cracks	No	No
External Colour	Good	Good
Internal Colour	Medium	Very good
Colour Defects	No	No
Pedice	Jointed	Jointed
Flavour	Medium	Medium

Selection	0219-3	0223-1	0223-2	0223-3
Generation	F ₃	F ₃	F ₃	F ₃
Maternal	(C33XArcadia)X((FloradadeXArcadia)XOntario7710)	Red Ruby	Red Ruby	Red Ruby
Paternal	AuroraXFirefox	Red Ruby	Red Ruby	Red Ruby
Bush Characteristics				
Vigour	Medium	Medium	Low-medium	Medium
Habit	Compact	Indeterminate	Indeterminate	Indeterminate
Maturity	Mid	Early-mid	Early-mid	Early-mid
Cover	Medium	Medium-sparse	Medium-sparse	Medium-sparse
Leaf Size	Medium	Medium	Medium	Medium-large
Leaf Colour	Mid	Dark	Dark	Dark
Leaf Roll	No	No	No	No
Yield	Medium	Good	Good	Good
Fruit Characteristics				
Shape	Round	Flat-round	Round-flat	Round-flat
Size	Medium-large	Medium-large	Small	Medium
Base Colour	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Small	Small	Small	Small-medium
Calyx Scar	Medium	Small-medium	Small	Small-medium
Firmness	Firm	Firm	Firm	Firm
Cracks	No	Concentric	No	No
External Colour	Good	Poor	Very good	Good
Internal Colour	Medium	Medium	Good	Good
Colour Defects	No	No	No	No
Pedicel	Jointed	Jointed	Jointed	Jointed
Flavour	Poor	Good	Very good	Poor-medium

Selection	0225-1	0225-2	0225-3	0225-4	0225-5	0225-6
Generation	F ₃	F ₃	F ₃	F ₃	F ₃	F ₃
Maternal	TA1355	TA1355	TA1355	TA1355	TA1355	TA1355
Paternal	TA1355	TA1355	TA1355	TA1355	TA1355	TA1355
Bush Characteristics						
Vigour	Medium-strong	Strong	Medium-strong	Medium-strong	Strong	Strong
Habit	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate
Maturity	Early	Early	Early	Early	Early	Early-mid
Cover	Medium-dense	Medium-dense	Dense	Medium	Medium-dense	Dense
Leaf Size	Medium-large	Large	Medium-large	Medium-large	Medium	Large
Leaf Colour	Dark	Dark	Dark	Dark	Dark	Dark
Leaf Roll	No	No	No	No	No	No
Yield	Very good	Very good	Very good	Very good	Very good	Very good
Fruit Characteristics						
Shape	Round-flat	Round-flat	Round	Round	Flat-round	Flat-round
Size	Medium-large	Small-medium	Small-medium	Small-medium	Medium	Medium-large
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Small	Small	Small	Small-medium	Small	Small
Calyx Scar	Medium	Small-medium	Small-medium	Small	Small	Medium-large
Firmness	Firm	Medium	Medium	Medium	Medium-firm	Medium-firm
Cracks	No	No	No	No	No	No
External Colour	Medium	Poor	Medium	Medium	Good	Very good
Internal Colour	Poor	Medium	Good	Poor	Good	Very good
Colour Defects	No	No	No	No	No	No
Pedicel	Jointed	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Poor	Poor	Good	Poor	Poor	Good

Selection	0225-7	0226-1	0226-2	0226-3	0228-1
Generation	F ₃	F ₃	F ₃	F ₃	F ₃
Maternal	TA1355	Red Ruby	Red Ruby	Red Ruby	TA1355
Paternal	TA1355	((2XRB))-5-5XK)-1-3	((2XRB))-5-5XK)-1-3	((2XRB))-5-5XK)-1-4	RR-2-1
Bush Characteristics					
Vigour	Strong	Medium-strong	Medium	Medium	Medium-strong
Habit	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate
Maturity	Early	Mid	Early-mid	Early-mid	Mid
Cover	Medium-dense	Medium-dense	Medium	Medium-sparse	Dense
Leaf Size	Large	Medium	Medium	Large	Medium-large
Leaf Colour	Dark	Dark	Dark	Dark	Dark
Leaf Roll	No	No	No	No	No
Yield	Good	Good	Medium	Very good	Good
Fruit Characteristics					
Shape	Round-flat	Round-flat	Round-flat	Round	Round
Size	Small-medium	Medium	Small-medium	Small-medium	Small-medium
Base Colour	Uniform	Green shoulder	Uniform	Uniform	Uniform
Blossom Scar	Small	Small	Small	Small	Small
Calyx Scar	Medium-large	Medium	Medium-large	Small-medium	Small-medium
Firmness	Medium	Medium-firm	Medium	Medium-firm	Medium
Cracks	No	No	No	No	No
External Colour	Good	Medium	Very good	Medium	Good
Internal Colour	Medium	Poor	Very good	Medium	Good
Colour Defects	No	No	No	No	No
Pedice	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Good	Medium	Good	Medium	Good

Selection	0228-2	0228-3	0228-4	0228-5	0228-6
Generation	F ₃	F ₃	F ₃	F ₃	F ₃
Maternal	TA1355	TA1355	TA1355	TA1355	TA1355
Paternal	RR-2-1	RR-2-1	RR-2-1	RR-2-1	RR-2-1
Bush Characteristics					
Vigour	Medium	Medium-strong	Strong	Medium-strong	Medium-strong
Habit	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate
Maturity	Early-mid	Early-mid	Mid	Early	Early-mid
Cover	Medium	Medium	Dense	Medium	Medium-dense
Leaf Size	Medium	Medium	Medium-large	Medium-large	Large
Leaf Colour	Dark	Dark	Dark	Dark	Dark
Leaf Roll	No	No	No	No	No
Yield	Medium	Very good	Very good	Good	Very good
Fruit Characteristics					
Shape	Round	Round	Flat-round	Flat-round	Round-flat
Size	Small	Small	Medium-large	Small-medium	Small-medium
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Small	Small	Small	Small	Small
Calyx Scar	Small-medium	Small-medium	Medium	Medium	Medium-large
Firmness	Medium-firm	Firm	Very firm	Very firm	Very firm
Cracks	No	No	No	No	No
External Colour	Very good	Good	Good	Very good	Very good
Internal Colour	Good	Good	Good	Good	Good
Colour Defects	No	No	No	No	No
Pedice	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Medium	Poor-medium	Very good	Good	Medium

Selection	0229-1	0229-2	0229-3	0230-1	0230-2
Generation	F ₃	F ₃	F ₃	F ₃	F ₃
Maternal	Petula	Petula	Petula	Red Ruby	Red Ruby
Paternal	RR-3-4	RR-3-4	RR-3-4	Red Ruby	Red Ruby
Bush Characteristics					
Vigour	Medium-strong	Medium	Medium-strong	Medium-strong	Medium-strong
Habit	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate
Maturity	Early	Mid	Mid	Mid-late	Early-mid
Cover	Medium-dense	Medium-sparse	Medium	Dense	Medium
Leaf Size	Medium	Medium	Medium	Large	Medium-large
Leaf Colour	Dark	Dark	Dark	Dark	Dark
Leaf Roll	No	No	No	No	No
Yield	Very good	Very good	Good	Good	Very good
Fruit Characteristics					
Shape	Flat-round	Round-flat	Flat-round	Flat-round	Flat-round
Size	Medium	Small-medium	Large	Medium-large	Small-medium
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Small-medium	Small-medium	Medium-large	Small-medium	Small
Calyx Scar	Medium-large	Medium	Medium-large	Medium-large	Medium-large
Firmness	Medium-firm	Firm	Medium-firm	Medium-firm	Firm
Cracks	No	No	Concentric	No	No
External Colour	Very good	Good	Very good	Medium	Good
Internal Colour	Good	Poor	Medium	Medium	Medium
Colour Defects	No	No	No	No	No
Pedicel	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Medium	Poor	Good	Poor	Poor

Selection	9810-3-1-1-1	9810-3-1-1-2	9810-3-1-2-1	9810-3-1-2-2	9810-3-1-2-3
Generation	F ₆	F ₇	F ₈	F ₉	F ₁₀
Maternal	Daniela	Daniela	Daniela	Daniela	Daniela
Paternal	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics					
Vigour	Medium	Medium	Medium	Medium	Medium
Habit	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate
Maturity	Mid	Early-mid	Mid	Mid	Mid
Cover	Medium	Medium	Medium-dense	Medium-dense	Medium
Leaf Size	Medium	Medium	Medium	Medium	Medium
Leaf Colour	Dark	Dark	Dark	Dark	Dark
Leaf Roll	No	No	No	No	No
Yield	Medium	Medium	Good	Medium	Good
Fruit Characteristics					
Shape	Flat-round	Flat-round	Flat-round	Round-flat	Flat-round
Size	Medium	Medium-large	Medium-large	Small-medium	Medium-large
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Small-medium	Small-medium	Small-medium	Small-medium	Small-medium
Calyx Scar	Medium	Medium	Medium-large	Medium	Medium-large
Firmness	Very firm	Very firm	Very firm	Very firm	Firm
Cracks	No	No	No	No	No
External Colour	Medium	Medium	Medium	Medium	Good
Internal Colour	Medium	Medium	Medium	Poor	Medium
Colour Defects	No	No	No	No	No
Pedicel	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Poor	Medium	Poor-medium	Medium	Poor-medium

Selection	9810-3-1-3-1	9810-3-2-2-1	9810-3-2-2-2	9810-3-2-3-1	9810-3-2-3-2
Generation	F ₁₁	F ₁₂	F ₁₃	F ₁₄	F ₁₅
Maternal	Daniela	Daniela	Daniela	Daniela	Daniela
Paternal	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora	ArcadiaXAurora
Bush Characteristics					
Vigour	Medium	Medium	Medium-strong	Low	Low-medium
Habit	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate
Maturity	Mid	Mid	Mid	Mid	Mid
Cover	Medium	Medium-dense	Medium-dense	Medium-dense	Medium-dense
Leaf Size	Medium	Medium	Medium	Medium	Medium
Leaf Colour	Dark	Dark	Mid	Dark	Mid
Leaf Roll	No	No	No	No	No
Yield	Medium	Good	Good	Good	Good
Fruit Characteristics					
Shape	Flat-round	Flat-round	Round-flat	Flat-round	Round-flat
Size	Medium	Medium-large	Medium-large	Medium	Medium
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Medium	Small-medium	Small-medium	Small-medium	Small-medium
Calyx Scar	Medium-large	Small-medium	Medium	Medium-large	Small-medium
Firmness	Very firm	Medium-firm	Medium-firm	Medium-firm	Medium-firm
Cracks	No	No	No	No	No
External Colour	Good	Medium	Medium	Good	Good
Internal Colour	Medium	Medium	Medium	Good	Medium
Colour Defects	No	No	No	No	No
Pedicel	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Poor	Poor-medium	Good	Good	Good

Selection	9810-3-2-3-3	9811-6-1-1-1	9811-6-1-1-2	9811-6-1-1-3	9811-6-1-4-1
Generation	F ₁₆	F ₁₇	F ₁₈	F ₁₉	F ₂₀
Maternal	Daniela	Daniela	Daniela	Daniela	Daniela
Paternal	ArcadiaXAurora	TristarXAurora	TristarXAurora	TristarXAurora	TristarXAurora
Bush Characteristics					
Vigour	Medium	Medium	Medium	Medium	Low-medium
Habit	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate
Maturity	Mid	Early-mid	Mid	Mid	Mid
Cover	Medium-sparse	Medium	Medium	Medium	Medium-sparse
Leaf Size	Medium	Medium	Medium	Medium	Medium
Leaf Colour	Dark	Dark	Dark	Dark	Dark
Leaf Roll	No	No	No	No	No
Yield	Good	Good	Good	Good	Medium
Fruit Characteristics					
Shape	Flat-round	Flat-round	Flat-round	Flat-round	Round-flat
Size	Medium-large	Medium	Medium	Medium-large	Medium
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Medium	Small	Small	Small	Small
Calyx Scar	Medium-large	Small-medium	Medium-large	Medium-large	Medium
Firmness	Medium	Very firm	Very firm	Very firm	Very firm
Cracks	Radial	No	No	No	No
External Colour	Medium	Good	Good	Medium	Medium
Internal Colour	Medium	Good	Very good	Medium	Good
Colour Defects	No	No	No	No	No
Pedicel	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Good	Good	Poor-medium	Medium	Good

Selection	9801-9-2-2-1	9801-9-3-1-1	9801-9-3-1-2	9801-9-3-2-1	9801-9-3-2-2
Generation	F ₂₁	F ₂₂	F ₂₃	F ₂₄	F ₂₅
Maternal	TristarXAurora	TristarXAurora	TristarXAurora	TristarXAurora	TristarXAurora
Paternal	Daniela	Daniela	Daniela	Daniela	Daniela
Bush Characteristics					
Vigour	Medium	Medium-strong	Medium-strong	Medium	Medium
Habit	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate
Maturity	Mid-late	Mid	Mid-late	Mid-late	Mid-late
Cover	Medium	Medium	Medium	Medium	Medium
Leaf Size	Medium	Medium	Medium	Medium	Medium
Leaf Colour	Mid	Mid	Mid	Mid	Mid
Leaf Roll	No	No	No	No	No
Yield	Medium	Good	Good	Medium	Medium
Fruit Characteristics	rin	rin	rin	rin	rin
Shape	Flat-round	Round-flat	Round-flat	Round-flat	Round-flat
Size	Large	Medium	Medium	Medium-large	Medium-large
Base Colour	Uniform	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Large	Medium	Medium-large	Medium	Medium-large
Calyx Scar	Small-medium	Small-medium	Medium	Small-medium	Small-medium
Firmness	Very firm	Very firm	Very firm	Very firm	Very firm
Cracks	No	No	No	No	No
External Colour	Poor	Poor	Poor	Poor	Poor
Internal Colour	Poor	Poor	Poor	Poor	Poor
Colour Defects	No	No	No	No	No
Pedicel	Jointed	Jointed	Jointed	Jointed	Jointed
Flavour	Poor	Poor	Poor	Poor	Poor

Selection	9801-9-3-3-1	9801-9-3-3-2	9801-9-3-4-1	Arcadia
Generation	F ₂₆	F ₂₇	F ₂₈	inbred
Maternal	TristarXAurora	TristarXAurora	TristarXAurora	
Paternal	Daniela	Daniela	Daniela	
Bush Characteristics				
Vigour	Medium-strong	Medium-strong	Medium	Medium-strong
Habit	Indeterminate	Indeterminate	Indeterminate	Compact
Maturity	Mid-late	Mid-late	Mid-late	Early-mid
Cover	Medium	Medium	Medium-sparse	Medium-sparse
Leaf Size	Medium	Medium	Medium	Medium
Leaf Colour	Mid	Mid	Mid	Mid
Leaf Roll	No	No	No	Some
Yield	Medium	Medium	Good	Good
Fruit Characteristics	rin	rin	rin	
Shape	Round-flat	Round-flat	Flat-round	Round
Size	Medium-large	Medium	Medium-large	Small-medium
Base Colour	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Small-medium	Small-medium	Small-medium	Medium
Calyx Scar	Medium	Medium	Small-medium	Small-medium
Firmness	Very firm	Very firm	Very firm	Firm
Cracks	No	No	No	No
External Colour	Poor	Poor	Poor	Medium
Internal Colour	Poor	Poor	Poor	Medium
Colour Defects	No	No	No	No
Pedicel	Jointed	Jointed	Jointed	Jointed
Flavour	Poor	Poor	Poor	Poor

Selection	Aurora	Rebel (for comparison)	T8601	T9202
Generation	inbred	F1 Hybrid	inbred	inbred
Maternal			C33	Tristar
Paternal			Arcadia	Aurora
Bush Characteristics				
Vigour	Medium-strong	Strong	Medium-strong	Medium-strong
Habit	Compact	Compact-upright	Compact	Compact
Maturity	Mid	Mid	Mid	Mid
Cover	Medium	Medium	Medium	Medium
Leaf Size	Medium	Medium-large	Medium	Medium
Leaf Colour	Mid	Mid	Mid	Mid
Leaf Roll	Some	Some	Some	Some
Yield	Good	Good	Good	Good
Fruit Characteristics				
Shape	Round	Globe	Round	Round
Size	Medium	Medium	Medium	Medium
Base Colour	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Small-medium	Small	Medium	Medium
Calyx Scar	Small-medium	Medium	Medium	Small-medium
Firmness	Firm	Firm	Firm	Firm
Cracks	No	No	No	No
External Colour	Medium	Good	Medium	Good
Internal Colour	Medium	Good	Good	Good
Colour Defects	No	No	No	No
Pedice	Jointed	Jointed	Jointed	Jointed
Flavour	Medium	Medium	Medium	Medium

Selection	T9204	T9215	T9334	T9343
Generation	inbred	inbred	inbred	inbred
Maternal	Aurora	Arcadia	Arcadia	Aurora
Paternal	Firefox	Aurora	Heinz2009	FloradadeXArcadia
Bush Characteristics				
Vigour	Medium-strong	Medium-strong	Medium-strong	Medium-strong
Habit	Compact	Compact	Compact	Compact
Maturity	Mid	Mid	Mid	Mid
Cover	Medium	Medium	Medium	Medium
Leaf Size	Medium	Medium	Medium	Medium
Leaf Colour	Mid	Mid	Mid	Mid
Leaf Roll	Some	Some	Some	Some
Yield	Good	Good	Good	Good
Fruit Characteristics				
Shape	Round-flat	Round-flat	Round	Round
Size	Medium-large	Medium	Medium-large	Medium-large
Base Colour	Uniform	Uniform	Uniform	Uniform
Blossom Scar	Medium	Medium	Small-medium	Small-medium
Calyx Scar	Medium	Small-medium	Small-medium	Small-medium
Firmness	Firm	Firm	Firm	Firm
Cracks	No	No	Concentric	No
External Colour	Good	Medium	Good	Good
Internal Colour	Good	Good	Good	Good
Colour Defects	No	No	No	No
Pedice	Jointed	Jointed	Jointed	Jointed
Flavour	Medium	Medium	Medium	Medium

Selection	AV6	AV9	T9708
Generation	F ₁	F ₁	inbred
Maternal			Ontario 7710X(VF53XArcadia)
Paternal			VF53XArcadia
Bush Characteristics	pto		
Vigour	Medium-strong	Medium	Medium
Habit	Compact	Compact	Compact-upright
Maturity	Mid	Early-mid	Mid
Cover	Medium	Medium	Medium
Leaf Size	Medium	Medium	Medium-large
Leaf Colour	Mid	Mid	Mid
Leaf Roll	Some	Some	Some
Yield	Good	Good	Medium
Fruit Characteristics			
Shape	Round-flat	Round-flat	Round
Size	Medium-large	Medium-large	Medium
Base Colour	Uniform	Uniform	Uniform
Blossom Scar	Small-medium	Medium	Small-medium
Calyx Scar	Small-medium	Small-medium	Small-medium
Firmness	Firm	Very firm	Firm
Cracks	No	No	No
External Colour	Good	Good	Medium
Internal Colour	Very good	Very good	Medium
Colour Defects	No	No	No
Pedice	Jointed	Jointed	Jointed
Flavour	Medium	Good	Poor

Selection	T9748A	T9748B
Generation	inbred	inbred
Maternal	C33XArcadia	C33XArcadia
Paternal	(FloradadeXArcadia)XOntario7710	(FloradadeXArcadia)XOntario7710
Bush Characteristics	pto	pto
Vigour	Medium	Medium
Habit	Compact-upright	Compact-upright
Maturity	Early-mid	Early-mid
Cover	Medium	Medium
Leaf Size	Medium-large	Medium-large
Leaf Colour	Mid	Mid
Leaf Roll	Some	Some
Yield	Medium	Medium
Fruit Characteristics		
Shape	Round	Round
Size	Medium	Small-medium
Base Colour	Uniform	Uniform
Blossom Scar	Small-medium	Small-medium
Calyx Scar	Medium	Small-medium
Firmness	Firm	Firm
Cracks	No	No
External Colour	Medium	Good
Internal Colour	Medium	Good
Colour Defects	No	No
Pedice	Jointed	Jointed
Flavour	Medium	Medium

Selection	T9748C	T9609A	T9609B
Generation	inbred	inbred	inbred
Maternal	C33XArcadia	AuroraXOntario7710	AuroraXOntario7710
Paternal	(FloradadeXArcadia)XOntario7710	Aurora	Aurora
Bush Characteristics	pto	pto	pto
Vigour	Medium	Medium-strong	Medium-strong
Habit	Compact-upright	Compact	Compact
Maturity	Early-mid	Mid	Early-mid
Cover	Medium	Medium	Medium
Leaf Size	Medium-large	Medium	Medium
Leaf Colour	Dark	Mid	Mid
Leaf Roll	Some	Some	Some
Yield	Medium	Medium	Medium
Fruit Characteristics			
Shape	Round-flat	Flat-round	Round-flat
Size	Medium-large	Medium-large	Medium-large
Base Colour	Uniform	Uniform	Uniform
Blossom Scar	Medium	Small-medium	Small-medium
Calyx Scar	Small-medium	Medium	Medium
Firmness	Firm	Very firm	Firm
Cracks	No	No	No
External Colour	Good	Good	Good
Internal Colour	Good	Medium	Medium
Colour Defects	No	No	No
Pediceal	Jointed	Jointed	Jointed
Flavour	Medium	Medium	Medium

Appendix 4:

AV6 and AV9 – Commercialisation Agreement