# Screening Vegetable Varieties from Asian Seed Companies for Australian Markets

Dr Donald Loch
GeneGro

Project Number: MT10044

**MT10044**

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# FINAL REPORT

## MT10044 (30 May 2013)

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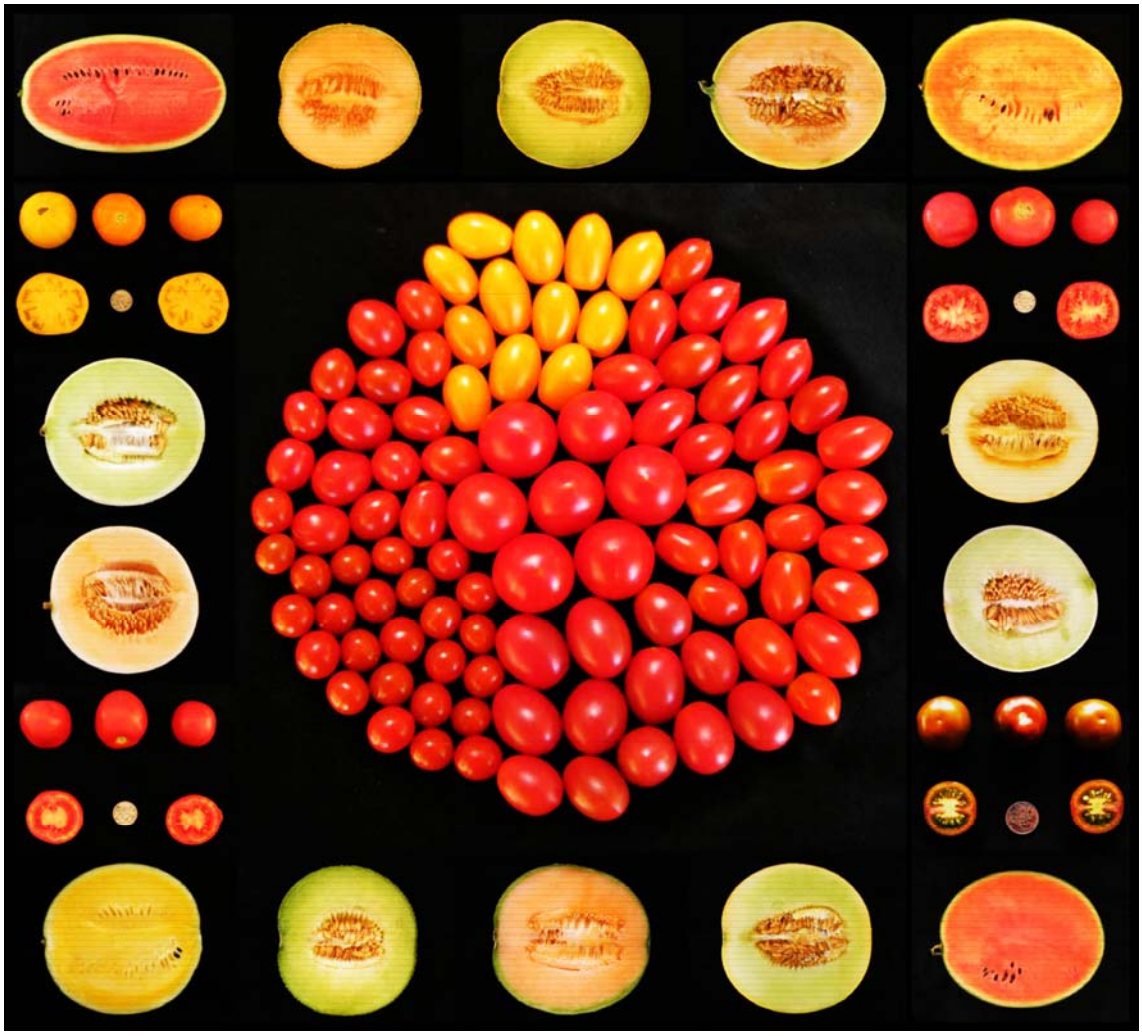

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**(* GeneGro Pty Ltd & The University of Queensland)**

**HAL Project -MT10044: Screening Vegetable Varieties from Asian Seed Companies for Australian Markets**

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## Purpose of Report

This report presents the results of field trials conducted in south-east Queensland over 2 years (2011/12 and 2012/13) to demonstrate the value of running local variety trials before committing to the large-scale import of seed of new vegetable varieties, using tomatoes, melons and watermelons as case examples.

## Acknowledgement

This project has been funded by HAL using voluntary contributions from Highsun Express Plugs Pty Ltd and matched funds from the Australian Government.

**Date**: 30 May, 2013

## Disclaimer



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# MEDIA SUMMARY

Field trials with new tomato, melon and watermelon varieties in south-east Queensland over 2 years (2011/12 and 2012/13) clearly demonstrated the value of running local variety trials before committing to the large-scale import of seed of new fruit and vegetable varieties. Around 40% of imported melon varieties were not resistant to local races of powdery and downy mildew diseases. A number of other watermelon, melon and tomato varieties proved to be poorly adapted to the new environment here and so were less productive than expected.

At the same time, several bite-sized grape tomato varieties of varying shapes and colours were well adapted and productive. The trials also included novel fruit types new to the Australian market:

- Small ‘icebox’ watermelons easier to fit into the family refrigerator;
- Delicious yellow-fleshed watermelons;
- Sweet honeydew melons with crisp white or orange flesh; and
- Green-fleshed rockmelons with earlier and more reliable flavour development and longer-lasting in storage.

# TECHNICAL SUMMARY

This report presents the results of irrigated field trials conducted in south-east Queensland over 2 years (2011/12 and 2012/13) to demonstrate the value of running local variety trials before committing to the large-scale import of seed of new fruit and vegetable varieties. In these trials, tomatoes, melons and watermelons were used as examples to assess:

- 33 tomato varieties imported from 6 different seed companies from Taiwan, Vietnam, Turkey, USA and Australia;
- 30 melon varieties from 6 different seed companies from Taiwan, Vietnam, China and USA; and
- 46 watermelon varieties from 6 different seed companies from Taiwan, Vietnam and China.

For each crop, the trial entries covered a variety of different genotypes based on growth habit, flesh/fruit colour, skin type, and fruit shape and size. The main aims of the first-year trials were to characterise and describe in broad terms the range of material being assessed, and to provide shortlists of promising new varieties from each of the three crops for inclusion in more detailed evaluation trials in the second year based on more detailed measurements and ratings of production and fruit quality.

These trials confirmed our hypothesis that imported fruit and vegetable varieties should first be evaluated in local variety trials In the case of the melons, around 40% of the 30 imported varieties were not resistant to local races of powdery and downy mildew diseases. A number of other watermelon, melon and tomato varieties also proved to be poorly adapted to the new environment here and so were less productive than expected, or in the case of 5 tomato varieties developed serious fruit blemishes.

At the same time, several bite-sized grape tomato varieties of varying shapes and colours proved well adapted and productive. The trials also included novel fruit types new to the Australian market:

- Small ‘icebox’ watermelons easier to fit into the family refrigerator;
- Delicious yellow-fleshed watermelons;
- Sweet honeydew melons with crisp white or orange flesh; and
- Green-fleshed rockmelons with earlier and more reliable flavour development and longer-lasting in storage.

Further work should be undertaken to facilitate the introduction and promotion of these new products to the Australian market.

# INTRODUCTION

Markets for vegetable seeds and seedlings are growing through increasing demand from both commercial producers and home gardeners. These two broad sectors have somewhat different requirements, with greater emphasis on productivity and reliability for commercial growers and greater interest in novelty, unusual and better flavoured varieties for home gardeners.

Over the past 20 years or so, vegetable breeding programmes by public research institutions in Australia have been progressively downsized or curtailed. Some of the slack here is being taken up by seed companies, which nowadays are not infrequently local subsidiaries of international companies. Increasingly, however, new varieties are, of necessity, being sourced from overseas breeding programmes and companies. Most of this planting material is imported through seed companies located in southern Australia where the main production areas have traditionally been located. However, reduced rainfall and increased droughts as predicted through global warming are expected to result in shifting future production more towards northern Australia where irrigation water supplies are more assured.

In addition to large global seed companies (e.g. Syngenta), there are a number of smaller independent Asian companies with active vegetable breeding programmes, in many cases interacting with researchers and breeders from the Asian Vegetable R&D Center located in tropical Taiwan. Notable among these are Known-You Seed (Taiwan), Chia Tai (Thailand), Green Seeds (Vietnam), East West (Thailand, Vietnam, the Philippines), Pang's Seed and Winall Hi-Tech Seed (China), many of which are located in tropical and subtropical climates.

Typically, overseas varieties sourced by Australian seed companies are initially purchased on the basis of their description and performance overseas, together with price. This is very much a "hit-and-miss" approach, with any large scale failures or "duds" being potentially costly and/or disappointing to growers, as shown through experience by Highsun Express Plugs Pty Ltd. For example, claims of resistance to major diseases may not hold up when exposed to different races of the causal organism in Australia; flavour and visual attributes may not suit Australian consumers; and some varieties may not prove as productive as found overseas. On the positive side, field trials by D.S. Loch and C.M. Zorin (unpublished data, 2008-10) with 40 melon and watermelon varieties sourced from independent Asian seed companies through personal contact have shown the rapid advances that can be made through local screening to select varieties with the best adaptation and potential for different parts of the market before moving to large-scale distribution and production. Tomatoes are another crop in which the range and diversity of varieties being offered is huge.

The objective of this 2-year project was to use tomatoes, melons (i.e. rockmelon, honey dew and related types) and watermelons as case examples to confirm the value of running local variety trials before committing to the large-scale import of seed of new vegetable varieties. In each case, a preliminary screening trial in year 1 was used to shortlist a smaller number of varieties for production trials in year 2 or for novelty appeal in non-commercial markets. In the case of watermelons, the original plan to initiate production trials on varieties shortlisted by Loch and Zorin (unpublished) was postponed to year 2 because of the large number of new overseas varieties that were sourced, mainly from Asian breeding programmes.

# EXPERIMENTAL

## Location and Site Preparation for Field Trials

Field trials in both years (2011/12 and 2012/13) were located on a fertile red volcanic Ferrosol (krasnozem) soil (Isbell 2002) at Birkdale, QLD (27°30'S, 153°14'E, 20 masl). Prior to each trial, the land was ripped twice (in different directions) and rotary hoed to a fine tilth.

For the melon trials in both years and the Year 1 watermelon trial, the cultivated soil was lightly hilled to form shallow (c. 10 cm high) raised beds 1 metre wide for planting, 3 metres apart and 80 metres long. T-tape for trickle irrigation was laid along the centre of each bed, two lines c. 20 cm apart in Year 1 to widen the zone irrigated around the plants but reduced to a single line of tape in Year 2.

The soil was hilled higher (to c. 15 cm) for the tomato trials in both years, the beds again 3 m apart and 80 m long. After laying a single line of T-tape down the centre of the planting hill, the beds were covered with black plastic mulch. The seedlings were later planted through 5-cm holes burnt in the plastic.

A basal fertiliser dressing was incorporated into each bed during the hilling process. This consisted of 5 kg of CK88 (N:P:K:S = 15.1:4.4:11.5:13.6) plus 2 kg Dynamic Lifter (N:P:K = 3.5:1.7:1.6) per 80-m long bed.

Temperature and rainfall data for the main experimental period in both years (Aug-Dec 2011 and 2012) are shown Table 1. Data for 2011 was recorded on site using a miniature Thermochron data logger button (OnSolution Pty Ltd, Sydney, NSW) and a standard rain gauge. Data shown for 2012 was recorded at Redlands HRS, the closest Bureau of Meteorology Weather Station to the experimental site. Long term average data for Redlands HRS are also shown in Table 1.

Temperatures in both years were close to average, except for one exceptionally cold frosty week in mid-August 2011 and heatwave conditions towards the end of the second-year field trial. The rainfall pattern, however, differed greatly between the two years: Good rainfall was received during the Year 1 trial, except for September and November which were quite dry. The second-year trial, however, coincided with an extended dry period from July 2012 through to late January 2013 (approximately 160 mm rainfall was received at the trial site from September through to late January); this was followed by heavy flood rains after completion of the trial; frequent heatwave conditions were experienced during the November-December period as the crops matured and into January, leading to sunburn on some late-picked rockmelons in particular.

## Year 1 Trials (2011/12)

### *Materials and Methods.*

Seed samples of varieties for trialling in this project were obtained from listings in various seed company catalogues as well as through face-to-face contact with vegetable seed suppliers among the 70 commercial companies displaying at the 2011 Asian Seed Congress (Asian Seed 2011) in Kaohsiung (Taiwan), among them a strong representation of seed companies located

**Table 1.** Monthly average daily temperatures and total rainfall, Aug-Dec 2011 and Aug-Dec 2012. *(Source: On-site weather records [2011]; Redlands HRS data - Bureau of Meteorology 2013.)*

| Year | Month | Temperature (°C) | | | Rainfall (mm) |
|---|---|---|---|---|---|
| | | Maximum | Minimum | Mean | |
| 2011 | August | 22.6 | 9.6 | 16.1 | 86 |
| | September | 24.8 | 10.5 | 17.6 | 10 |
| | October | 25.8 | 13.9 | 19.9 | 108 |
| | November | - | - | - | 16 |
| | December | - | - | - | 132 |
| 2012 | August | 22.6 | 8.1 | 15.4 | 0 |
| | September | 23.9 | 11.3 | 17.6 | 14 |
| | October | 25.8 | 13.1 | 19.5 | 28 |
| | November | 27.5 | 16.0 | 21.8 | 84 |
| | December | 30.2 | 18.5 | 24.4 | 38 |
| Averages | August | 21.6 | 8.3 | 15.0 | 52 |
| (1953-2013) | September | 23.6 | 11.0 | 16.8 | 38 |
| | October | 25.3 | 14.1 | 19.7 | 84 |
| | November | 26.9 | 16.7 | 21.8 | 103 |
| | December | 28.2 | 18.7 | 23.5 | 142 |

in tropical and subtropical regions in the northern hemisphere including a number of Taiwanese companies that had not attended and/or mounted a display at previous Asian Seed congresses (see also Appendix 1). Numbers of trial entries were as follows:

- 33 tomato varieties from 6 different seed companies from Taiwan, Vietnam, Turkey, USA and Australia (Table 2; see also Appendix 2);
- 29 melon varieties from 6 different seed companies from Taiwan, Vietnam, China and USA (Table 3; see also Appendix 3); and
- 46 watermelon varieties from 6 different seed companies from Taiwan, Vietnam and China (Table 4; see also Appendix 4).

In each case, the trial entries covered a variety of different types based on growth habit, flesh/fruit colour, skin type, and fruit shape and size. Tomatoes included determinate, semi-determinate and indeterminate growth habits; fruit size ranging from large (>200g each) to small (10-20 g each, or less); and red/pink, orange, brown and yellow fruit ranging from globular to oblong in shape. The range of tomato varieties that could be accessed as well as the companies that could supply seed that meets Australian Quarantine requirements was restricted

by Quarantine regulations designed to ensure that imported tomato seed is free of potato spindle tuber virus. Nevertheless, seed of 33 tomato varieties was obtained, covering the more traditional types as well as small grape tomato varieties (increasing in popularity on the Australian fresh fruit market) and novelty types. The following abbreviations have been used in this report to identify the various companies from which seed was sourced for these trials.

- KY – Known-You Seed Co. Ltd (Taiwan)
- Pang's - Hefei Pang's Agro-Products C. Ltd (PR China)
- Tunfeng - Anhui Tunfeng Seed Co., Ltd (PR China)
- Winall – Winall Hi-Tech Seed Co., Ltd (PR China)
- Greens – Green Co. Ltd (Vietnam)
- Yuk-Ant - Yüksel Seeds Ltd (Turkey)
- HED Seed Productions Ltd, Inc. (California, USA)
- SBD - Seeds By Design Inc. (California, USA)
- Westerns – Western Hybrid Seeds, Inc. (California, USA)
- Ace – Ace Ohlsson Pty Ltd (Australia)
- NGS – New Gippsland Seeds & Bulbs (Australia)

Beginning on 1 Jul 2011 (tomatoes) and 29 Jul 2011 (melons, watermelons), seedlings for field trials were germinated by Highsun Express Plugs in cell trays filled with a peat-vermiculite medium. The single seedling plugs were subsequently planted in the field on 28 Jul and 4 Aug 2011 (duplicate plantings of tomato varieties on 2 mulched beds, with 5 seedlings per variety plot at 40 cm spacings along each bed), 17 Aug and 17 Sep 2011 (melons in two groups as seedlings developed fully for transplanting, 4 seedlings close together per variety, 2.7 m between varieties), and 25 Aug and 17 Sep 2011 (watermelons in two groups as seedlings developed fully for transplanting, 4 seedlings close together per variety, 3.5 m between varieties). Because of the numbers of varieties and the area required for the vines produced by each entry, melon and watermelon plots were not duplicated in these initial screening trials with only a single 4-plant plot of each variety grown. Some early replacements of tomato seedlings were necessary as a result of unusually cold weather with some light frosts during mid-August (9-16 Aug).

All trial plantings received regular trickle irrigation as required, increasing to daily applications as temperatures rose in late spring and summer. In the case of the watermelons (which were not hilled), an initial application of c. 200 g of CK88 was made around each 4-plant varietal group. Urea was applied to all plantings (tomato, melon and watermelon) through trickle irrigation in November at the rate of 150 g per 80 m row. Weeds were controlled manually as required. In the case of the relatively large area under watermelons, pendimethalin (Rifle® 440) was applied immediately after planting at label rates to supress the later germination of weed seeds.

The young tomato seedlings were sprayed with chlorpyrifos (Lorsban®) to control cutworms after transplanting and pirimicarb (Pirimor®) for aphids. Trellising to support the mature tomato plants was erected during early growth in the field, and the growing plants trained up through this. Regular applications of Yates Tomato Dust (a mixture of sulphur, copper oxychloride and spinosad) were made and sprayed with mancozeb (Mancozeb®) at label rates to control leaf diseases as required. QFF fruit fly traps were set up as fruit began to ripen in mid-October, and sprayed with chlorantraniliprole (Coragen®) in November to control lepidopterous caterpillars damaging the fruit. Assessments were made of plant habit (D =

determinate, SD = semi-determinate, I = indeterminate), fruit size and type, and a preliminary assessment of eating quality made via taste tests among Highsun staff.

Melons and watermelons were sprayed with mancozeb in early November. Fruit ripened from mid-December through to about mid-January. Assessments were made of disease resistance (powdery mildew initially, later downy mildew as well) and fruit type; numbers and weight of fruit were recorded; and a preliminary assessment of eating quality made via taste tests by the research team.

***Results.*** The main aims of the Year 1 trials were to characterise and describe in broad terms the range of material being assessed, and to provide shortlists of promising new varieties from each of the three crops for inclusion in more detailed evaluation trials in Year 2.

The 33 tomato varieties covered a wide range of material from indeterminate to determinate habit, and from small 5-20 g grape tomatoes globular to oblong in shape (including pear, plum and elliptical shapes as described by Goldman and Schrager 2008) through to the more traditional large round and beefsteak varieties producing individual fruits >200 g each (Table 2, Plate 1). The entries were predominantly red in colour, but also included 7 yellow, 2 orange, 1 pink, and 2 novel brownish-red varieties. Visually, all 33 tomato varieties appeared at least reasonably productive. However, the results of two initial taste tests among Highsun staff members proved inconclusive and conflicting, both between and within each taste test (Table 3). Some of the more consistent comments are also shown in that table. In reaching the shortlist highlighted in Table 2, more reliance was placed on assessments by the research team and Highsun management, both of whom had experience of all varieties over an extended period.

Melons included the widely-grown netted skin rockmelon or cantaloupe type with orange flesh (e.g. the industry standard Planter's Jumbo – Mel 29); honey dew types with green, orange or white flesh; varieties with normal orange rockmelon flesh but with no netting on the skin; netted rockmelons with green flesh, and miscellaneous Hami and novelty types (Mel 22, Mel 25) as shown in Table 4. The third and fourth groups are distinctly different from the orange-fleshed rockmelons traditionally grown in Australia, and included some promising varieties that looked well adapted, productive and tasty. The initial selection of promising varieties for continued trialling was based very strongly on disease resistance, coupled with productivity and eating quality assessment. Around mid-November 2011, some melon varieties started to show increasing damage from powdery mildew, while the majority showed virtually no effect. As this seemed to be an opportunity to cull disease-prone varieties through natural attrition, the decision was taken not to spray with fungicide. Instead, disease continued to develop and kill the vines of about a dozen varieties over the next month (Plates 4-6). Initially, disease pressure was mainly from powdery mildew (Plate 5), but downy mildew (Plate 6) had also entered the mix by early December. Effectively, all of the shortlisted melon varieties were demonstrably more disease resistant than the industry standard, Planters Jumbo (Mel 29 – Table 4; Plate 6), including the late-planted Mel 76 which could not be evaluated for production.

The watermelon trial focussed particularly on the small "icebox" category with either red or yellow/orange flesh, mostly seeded but also included some seedless varieties (both red and yellow flesh) and larger, more traditional watermelons (Table 5). Watermelon skin colour varied from dark to mid-green with or without stripes; and shape ranged from rounded to oblong. Although the watermelon plants did not appear to grow as well un-hilled in Year 1 (hence the decision to hill them successfully in Year 2), there was still considerable variation in productivity on which to base the shortlisting of varieties, together with eating quality.

**Table 2.** Sources and plant and fruit characteristics of tomatoes grown in Year 1 trials at Birkdale, QLD. See text for seed company and growth habit codes used. Varieties shortlisted for second-year trials are highlighted in orange.

| Planting code | Variety name | Source | Growth habit | Fruit colour | Average fruit weight(g) |
|---|---|---|---|---|---|
| Tom 01 | Aria | KY | SD | Yellow | 11.5 |
| Tom 02 | Chica | KY | I | Red | 16.6 |
| Tom 03 | Floridity | KY | I | Red | 14.8 |
| Tom 04 | Golden Gem | KY | I | Yellow | 12.9 |
| Tom 05 | Golden Sweet | KY | I | Yellow | 12.4 |
| Tom 06 | Orito | KY | I | Yellow | 15.1 |
| Tom 07 | Ruby | KY | I | Red | 6.7 |
| Tom 08 | Solar | KY | I | Red | 21.1 |
| Tom 09 | Rojita | KY | I | Pink | 16.5 |
| Tom 10 | Tropical Ruby | KY | SD | Red | 12.9 |
| Tom 11 | Grace (Beef King) | KY | I | Red | 170.7 |
| Tom 12 | Golden Shine | KY | I | Yellow | 171.7 |
| Tom 13 | Caracoli | Greens | I | Red | 125.3 |
| Tom 14 | Daran | Greens | I | Red | 110.0 |
| Tom 15 | An67 (Mariner) | Greens | D | Red | 86.0 |
| Tom 16 | Mongal (Patio Supreme) | Greens | D | Red | 119.0 |
| Tom 17 | Tropic | Greens | SD | Red | 166.3 |
| Tom 18 | TyQueen (TyRex) | Greens | D | Red | 150.0 |
| Tom 19 | Beef Maestro | SBD | I | Red | 212.0 |
| Tom 20 | Carmelita | SBD | I | Red | 120.0 |
| Tom 21 | Celebration | SBD | D | Red | 262.7 |
| Tom 22 | Honeybee | SBD | SD | Yellow | 20.7 |
| Tom 23 | Ladybug | SBD | I | Red | 10.7 |
| Tom 24 | Monarch | SBD | I | Orange | 20.0 |
| Tom 25 | Orange Pixie | SBD | D | Orange | 39.3 |
| Tom 26 | Sunnyboy | SBD | D | Yellow | 270.7 |
| Tom 27 | Sugar Plum | SBD | I | Red | 10.7 |
| Tom 28 | Tastemaster | SBD | I | Red | 247.3 |
| Tom 29 | Sweet Cherry | Westerns | I | Red | 13.0 |
| Tom 30 | Super Prize | Ace | D | Red | 190.0 |
| Tom 31 | Kaluha (Brown Cocktail) | Yuk-Ant | I | Brownish-red | 39.6 |
| Tom 32 | Sacher (Brown Gourmet) | Yuk-Ant | I | Brownish-red | 106.4 |
| Tom 33 | Zola | NGS | I | Red | 193.3 |

**Table 3.** Mean preference ratings (1 = worst, 5 = best) from tomato variety taste tests conducted 18 Nov 2011 with Highsun staff.

| Planting code | Variety name | Preference Ratings | | Comments |
|---|---|---|---|---|
| | | Test 1 (means of 10) | Test 2 (means of 3) | |
| Tom 01 | Aria | 2.9 | - | Tough/firm skin |
| Tom 02 | Chica | 4.0 | - | Thick/firm skin |
| Tom 03 | Floridity | 3.3 | - | Interesting, unusual shape; tough skin |
| Tom 04 | Golden Gem | 3.0 | - | |
| Tom 05 | Golden Sweet | 2.7 | - | |
| Tom 06 | Orito | 2.5 | - | Bland |
| Tom 07 | Ruby | 3.6 | - | Sweet; good flavour |
| Tom 08 | Solar | 3.2 | - | Thick skin; firm flesh |
| Tom 09 | Rojita | 3.2 | - | |
| Tom 10 | Tropical Ruby | 3.2 | - | |
| Tom 13 | Caracoli | - | 3.4 | |
| Tom 14 | Daran | - | 2.7 | |
| Tom 15 | An67 (Mariner) | - | 1.4 | |
| Tom 16 | Mongal (Patio Supreme) | - | 2.8 | |
| Tom 17 | Tropic | - | 2.6 | |
| Tom 18 | TyQueen (TyRex) | - | 3.9 | |
| Tom 19 | Beef Maestro | - | 3.5 | |
| Tom 20 | Carmelita | - | 3.1 | |
| Tom 21 | Celebration | - | 4.6 | |
| Tom 22 | Honeybee | 2.5 | 4.3 | Soft flesh |
| Tom 23 | Ladybug | 3.3 | 3.1 | Soft flesh |
| Tom 24 | Monarch | 3.0 | 3.0 | Soft flesh |
| Tom 25 | Orange Pixie | 2.8 | 3.4 | Bland |
| Tom 26 | Sunnyboy | 4.0 | 2.6 | Soft; not sweet |
| Tom 27 | Sugar Plum | - | 2.2 | |
| Tom 29 | Sweet Cherry | 3.2 | 2.9 | Tough skin |
| Tom 30 | Super Prize | - | 4.1 | Real tomato taste |
| Tom 31 | Kaluha (Brown Cocktail) | 4.0 | 1.2 | |
| Tom 32 | Sacher (Brown Gourmet) | - | 2.7 | |
| Tom 33 | Zola | - | 3.4 | |

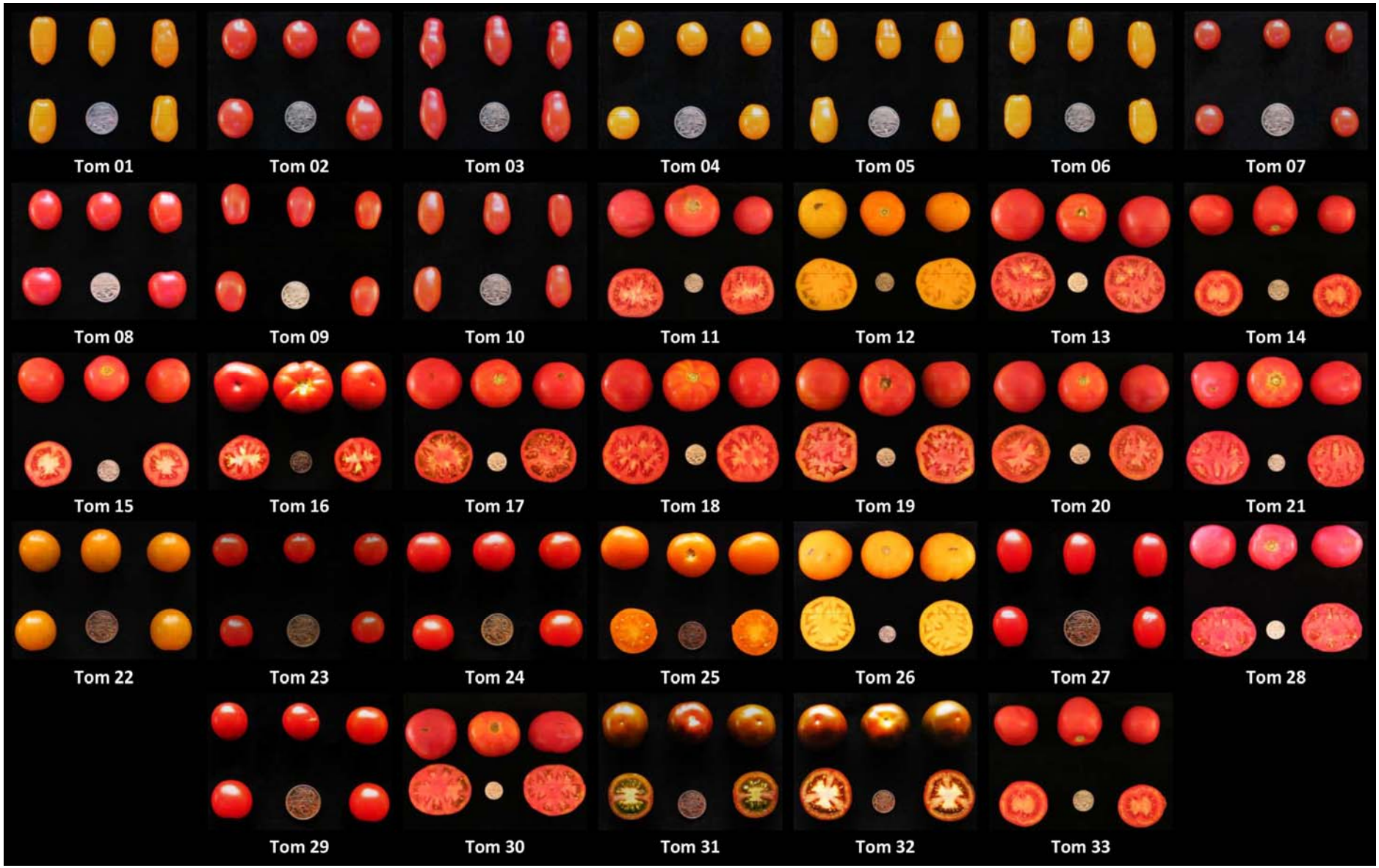


**Plate 1.** Fruit characteristics of tomato varieties in Year 1 trial, each shown relative to the size of a 20-cent piece.

**Table 4.** Sources and plant and fruit characteristics of melons grown in Year 1 trials at Birkdale, QLD. See text for seed company codes used. Varieties shortlisted for second-year trials are highlighted in orange.

| Planting code | Variety Name | Source | Plant Survival (14/12/11) | Fruit per plot | | | | | Eating qualities |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Outer rind | Flesh | Total no. | Total weight (kg) | Average size (kg) | |
| Mel 01 | Amy | KY | × | Smooth | White | 16 | 13.3 | 0.830 | Fruit rotted before ripe |
| Mel 02 | Sophy | KY | ✓ | Netted | Orange | 10 | 6.8 | 1.365 | Bland |
| Mel 03 | Angel | KY | ✓ | Smooth | Pale orange | 11 | 7.2 | 0.657 | Sweet soft flesh |
| Mel 04 | Emerald Sweet | KY | × | Netted | Green | 2 | 1.0 | 0.511 | Bland |
| Mel 05 | Red Aroma | KY | ✓ | Netted | Orange | 8 | 8.9 | 1.107 | Sweet aromatic flavour |
| Mel 06 | Lacus | KY | × | Netted | Orange | 11 | 11.9 | 1.194 | Sweet aromatic flavour; small seed cavity |
| Mel 07 | Dignity | KY | × | Netted | Orange | 8 | 4.1 | 0.515 | Bland |
| Mel 08 | Bright Century | KY | × | Netted | Orange | 6 | 5.2 | 1.038 | Bland |
| Mel 09 | Golden Lady | KY | × | Smooth | Pale green | 4 | 1.8 | 0.603 | Sweet |
| Mel 10 | Honey World | KY | ✓ | Smooth | Green | 11 | 16.9 | 1.689 | Sweet honeydew type) |
| Mel 11 | Diosa | KY | ✓ | Smooth | Green | 5 | 8.9 | 2.228 | Sweet honeydew type |
| Mel 12 | Silver World | KY | × | Smooth | Green | 3 | 7.3 | 3.633 | Sweet honeydew type |
| Mel 13 | Red Queen | KY | ✓ | Smooth | Orange | 10 | 10.9 | 1.207 | Strong sweet aromatic flavour |
| Mel 14 | Papayadew | HED | ✓ | Smooth | Orange | 15 | 17.4 | 1.163 | Strong sweet aromatic flavour |
| Mel 15 | HT 6040 | HED | ✓ | Netted | Green | 9 | 11.7 | 1.299 | Excellent; sweet firm flesh |
| Mel 16 | QY041 | Winall | × | Smooth | Pale orange | 11 | 10.47 | 1.164 | Fair flavour; crisp flesh |
| Mel 17 | PS040 | Pang's | × | Smooth | Pale green | 7 | 5.3 | 0.763 | Sweet |
| Mel 18 | PS040A | Pang's | × | Smooth | Pale orange | 10 | 13.81 | 1.381 | Sweet |
| Mel 19 | HM002 | Pang's | × | Smooth | Pale orange | 7 | 2.9 | 0.407 | - |
| Mel 20 | HM003 | Pang's | ✓ | Smooth | White | 21 | 26.6 | 1.475 | Crisp flesh, not over sweet |
| Mel 21 | HM005 | Pang's | × | Lightly netted | Orange | 3 | 3.8 | 1.890 | - |
| Mel 22 | HM006 | Pang's | ✓ | Lightly netted | Pale orange | 12 | 13.1 | 1.450 | Sweet, crisp Hami type |
| Mel 23 | Sunshine | Tunfeng | × | Smooth | Pale orange | 5 | 2.1 | 0.409 | - |
| Mel 24 | Jin Rui | Tunfeng | × | Smooth | White | 10 | 12.0 | 1.715 | Crisp flesh, not over sweet |
| Mel 25 | Grand Golden Sweet | Tunfeng | ✓ | Smooth | White | 9 | 3.0 | 0.435 | Very sweet; small fruit |
| Mel 26 | Alien | Greens | ✓ | Netted | Mid-green | 15 | 18.9 | 1.257 | Excellent; sweet firm flesh |
| Mel 27 | Arkanga | Greens | ✓ | Netted | Dark green | 21 | 22.1 | 1.471 | Excellent; sweet firm flesh |
| Mel 28 | Supra | Greens | × | Almost smooth | Orange | 11 | 8.1 | 0.738 | Crisp flesh, not over sweet |
| Mel 29 | Planters Jumbo | Standard | × | Netted | Orange | 9 | 10.3 | 1.143 | Sweet aromatic flavour |

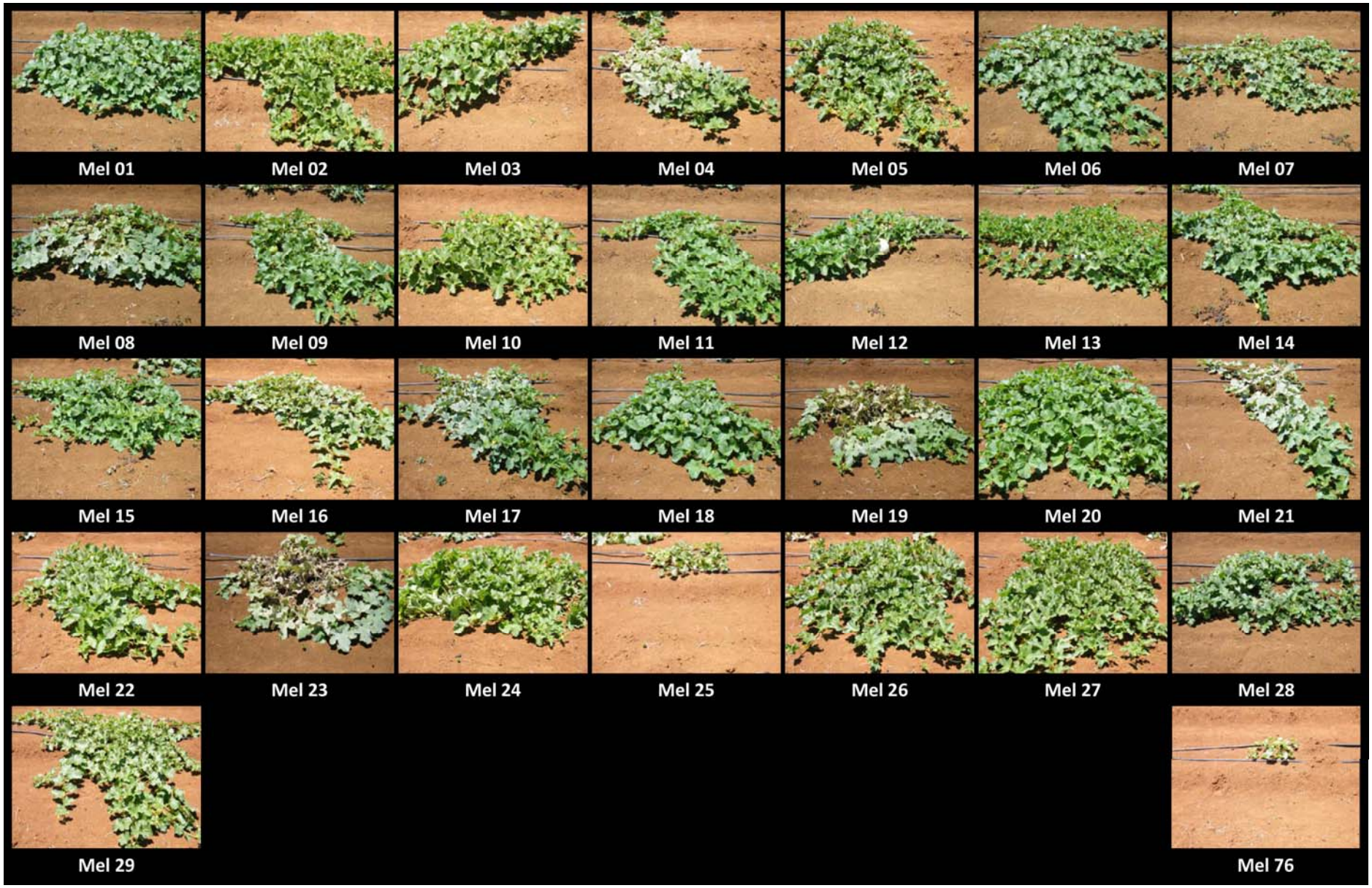


**Plate 2.** Early development of leaf diseases on melon varieties in Year 1 trial, 19 Nov 2011.


**Plate 3.** Progressive development of leaf diseases on melon varieties in Year 1 trial, 4 Dec 2011.


**Plate 4.** Advanced development of leaf diseases on melon varieties in Year 1 trial, 14 Dec 2011.

**Table 5.** Sources and plant and fruit characteristics of watermelons grown in Year 1 trials at Birkdale, QLD. See text for seed company codes used. Varieties shortlisted for second-year trials are highlighted in orange.

| Planting code | Variety Name | Source | Fruit | | Fruit per plot | | | Fruit qualities |
|---|---|---|---|---|---|---|---|---|
| | | | Outer rind | Flesh | Number | Total weight (kg) | Average size (kg) | |
| Mel 30 | Flower Dragon | KY | Light green striped | Red | 3 | 6.27 | 2.09 | Good sweet flavour |
| Mel 31 | Bright Gem | KY | Dark green striped | Red | 4 | 11.86 | 2.97 | Good sweet flavour; thin rind |
| Mel 32 | Fine Light | KY | Light green striped | Red | 2 | 8.01 | 4.01 | Good sweet flavour |
| Mel 33 | Cathay Belle | KY | Light green striped | Red | 1 | 0.07 | 0.07 | - |
| Mel 34 | Dark Belle | KY | Dark green | Red | 7 | 3.62 | 0.52 | Good sweet flavour |
| Mel 35 | Showing | KY | Light green striped | Red | 4 | 10.07 | 2.52 | Good sweet flavour; thin rind |
| Mel 36 | Southern Light | KY | Dark green | Red | 5 | 17.34 | 3.47 | Good sweet flavour |
| Mel 37 | Famed Lady | KY | Mid-green | Red | 5 | 8.28 | 1.66 | Flavour bland? |
| Mel 38 | Sweet Beauty | KY | Light green striped | Red | 5 | 9.11 | 1.82 | Good sweet flavour |
| Mel 39 | Feeling | KY | Light green striped | Red | 4 | 1.24 | 0.31 | Very sweet |
| Mel 40 | Grand Duchess | KY | Dark green | Red | 4 | 2.29 | 0.57 | Good sweet flavour |
| Mel 41 | Sureness | KY | Light green striped | Yellow | 6 | 20.71 | 3.45 | Very sweet, excellent flavour |
| Mel 42 | Diana | KY | Golden yellow | Pink-red | 4 | 5.57 | 1.39 | Good flavour, not strong |
| Mel 43 | New Queen | KY | Light green striped | Salmon | 4 | 2.70 | 0.68 | Good sweet flavour |
| Mel 44 | New Orchid | KY | Light green striped | Salmon | 7 | 14.37 | 2.05 | Good sweet flavour |
| Mel 45 | Peace | KY | - | - | 0 | 0.00 | - | No fruit |
| Mel 46 | Yellow Baby | KY | Light green striped | Yellow | 2 | 1.21 | 0.61 | Good sweet flavour |
| Mel 47 | Petite Yellow | KY | Light green striped | Yellow | 3 | 5.14 | 1.71 | Good sweet flavour |
| Mel 48 | Gentility | KY | Mid-green striped | Red | 3 | 6.93 | 2.31 | Seedless |
| Mel 49 | Queenlet | KY | Dark green striped | Red | 3 | 4.73 | 1.58 | Seedless |
| Mel 50 | Felicity | KY | Light green striped | Yellow | 1 | 7.40 | 7.40 | Seedless |
| Mel 51 | Orchid Sweet | KY | Light green striped | Yellow | 3 | 11.80 | 3.93 | Seedless |

| Planting code | Variety Name | Source | Fruit | | Fruit per plot | | | Fruit qualities |
|---|---|---|---|---|---|---|---|---|
| | | | Outer rind | Flesh | Number | Total weight (kg) | Average size (kg) | |
| Mel 52 | Prosperity | KY | Dark green | Red | 3 | 9.33 | 3.11 | Seedless |
| Mel 53 | Farmers Wonderful | KY | Light green striped | Red | 1 | 10.00 | 10.00 | Seedless |
| Mel 54 | Ring 601 (QY028) | Winall | Dark green | Red | 4 | 5.83 | 1.46 | Excellent flavour, dense flesh |
| Mel 55 | Ring 603 (QY029) | Winall | Dark green | Red | 3 | 3.34 | 1.11 | Excellent flavour, dense flesh |
| Mel 56 | Y1014 | Winall | Light green striped | Red | 1 | 3.17 | 3.17 | Good sweet flavour |
| Mel 57 | Y1018 | Winall | Light green striped | Red | 3 | 5.29 | 1.76 | Good sweet flavour |
| Mel 58 | Y1046Y | Winall | Light green striped | Red | 2 | 1.85 | 0.92 | Good sweet flavour |
| Mel 59 | PS034 | Pang's | Light green striped | Yellow | 2 | 3.86 | 1.93 | Good sweet flavour |
| Mel 60 | PS035 | Pang's | Light green striped | Red | 7 | 7.25 | 1.04 | Good sweet flavour |
| Mel 61 | PS036 | Pang's | Dark green striped | Red | 7 | 9.39 | 1.34 | Good sweet flavour |
| Mel 62 | PS036B | Pang's | Dark green striped | Red | 4 | 5.28 | 1.32 | Good sweet flavour |
| Mel 63 | Golden Sun | Tunfeng | Golden striped | Red | 6 | 12.92 | 2.15 | Good sweet flavour |
| Mel 64 | Golden Beauty | Tunfeng | Golden striped | Red | 3 | 2.24 | 0.75 | |
| Mel 65 | Typhoon | Greens | Dark green striped | Red | 5 | 7.56 | 1.51 | Excellent flavour, dense flesh |
| Mel 66 | #555 | Greens | Light green striped | Red | 3 | 3.21 | 1.07 | Good sweet flavour; thin rind |
| Mel 67 | Baby Dragon 2 | Greens | Light green striped | Red | 4 | 16.39 | 4.10 | Good sweet flavour |
| Mel 68 | Dark Belle | Greens | Dark green striped | Red | 5 | 12.25 | 2.45 | Good sweet flavour; dense |
| Mel 69 | Dark Dragon | Greens | Dark green striped | Red | 5 | 10.44 | 2.09 | Good sweet flavour; dense |
| Mel 70 | Dragon Skin | Greens | Dark green striped | Red | 5 | 5.11 | 1.02 | Good sweet flavour |
| Mel 71 | New Dragon Skin | Greens | Mid-green striped | Red | 4 | 4.83 | 1.21 | Good sweet flavour |
| Mel 72 | New Belle | Greens | Dark green striped | Red | 3 | 4.34 | 1.45 | Good sweet flavour; dense |
| Mel 73 | Sugar Belle | Greens | Dark green striped | Red | 6 | 7.48 | 1.25 | Good sweet flavour; dense |
| Mel 74 | Pure Gold | Greens | Dark green | Red | 7 | 20.05 | 2.86 | Not true-to-type |
| Mel 75 | Golden Tiger | Greens | Light green striped | Orange-yellow | 2 | 2.66 | 1.33 | Sweet dense golden flesh |

**Plate 5.** Melon variety showing susceptibility to powdery mildew.

**Plate 6.** Downy mildew developing on melon leaves.

Selection of the more promising varieties for Year 2 trials was based on taste and performance data from the Year 1 trials, particularly yield and disease resistance in the case of the melons and watermelons, while bearing in mind the need to retain representatives in each of the major sub-categories within each of the crops, provided these also showed reasonable promise in terms of adaptation. Shortlisted varieties are shown in Table 1, with total numbers in each category as follows:

- 19 tomato varieties from 4 seed companies;
- 16 rockmelon varieties from 6 seed companies; and
- 24 watermelon varieties from 5 seed companies.

**Year 2 Trials (2012/13)**

***Materials and Methods.*** The varieties shortlisted from the Year 1 trials continued on into the Year 2 trials. Numbers of trial entries in the second year were as follows:

- 18 tomato varieties from 3 different seed companies from Taiwan, Vietnam and USA (Table 2 and 5);
- 16 melon varieties from 6 different seed companies from Taiwan, Vietnam, China and USA (Table 3 and 6); and
- 23 watermelon varieties (excluding the original shortlisted Mel 75 due to a lack of planting seed remaining) from 5 different seed companies from Taiwan, Vietnam and China (Table 4 and 7).

Beginning on 30 Aug 2012, seedlings for these field trials were germinated by Highsun Express Plugs in cell trays filled with a peat-vermiculite medium. The single seedling plugs were subsequently planted out in the field on 29 Sep (tomatoes, melons) and30 Sep 2012 (watermelons). With reduced numbers of varieties compared with the first year trials, duplicate plantings of all three species – tomatoes, melons and watermelons – were made in two randomised blocks. Tomatoes and melons each occupied one full 80 m bed, while the watermelons with their greater plant spread required 2 beds. The tomatoes were again planted at 40 cm spacings along the bed, with either 5 seedlings (Block 1) or 4 seedlings (Block 2) per plot. The melons and watermelons were planted as groups of 6 seedlings per plot either side of the trickle tape, with either 2.5 m (melons) or 3.3 m (watermelons) between varieties. Early losses of plants (e.g. from damping off, wind damage, etc) were replaced from the same batch of seedling plugs during the first few weeks.

All trial plantings received regular trickle irrigation as required, increasing to daily applications as temperatures rose and dry conditions intensified in late spring and summer as shown by rainfall data in Table 1. Urea was applied to all plantings (tomato, melon and watermelon) through trickle irrigation in November at the rate of 150 g per 80 m row. Weeds emerging in the planting beds were controlled manually as required, with pendimethalin (Rifle® 440) applied between beds immediately after planting at label rates to supress the later germination of weed seeds.

Trellising to support the mature tomato plants was erected during early growth in the field, and the growing plants trained up through this. Regular applications of Yates Tomato Dust were again made to control pests and diseases; QFF fruit fly traps were set up as fruit began to ripen in early November, and the plants were sprayed twice with chlorantraniliprole (Coragen®) to control lepidopterous caterpillars damaging the fruit. Assessments were again

made of plant habit, fruit size and type, plus a rating for productivity, noting any perceived production and fruit quality faults, and a rating for eating quality assessed via taste tests.

During November, the melons and watermelons were sprayed with mancozeb+metalaxyl–m (Ridomil® MZ) followed by a later spray of fenarimol (Rubigan®) to control leaf diseases Fruit ripened from mid-December onwards. Assessments were again made of disease resistance and fruit type; numbers and weight of fruit were recorded; and eating quality assessed via taste tests by the research team.

Assessments and data collection on all three crops were completed by the end of December 2012. All ratings were made on a 1-5 scale with 1 = worst, 5 = best. Where applicable, data were analysed through GenStat Release 12.1 for Windows (VSN International Ltd, Hemel Hempstead, UK) using standard Analysis of Variance procedures, which also generated Fisher's protected Least Significant Differences (LSDs) for comparison of treatment means.

***Results.*** All of the shortlisted tomato varieties showed good to excellent production potential in Year 2 (Table 6). However, a high incidence of fruit faults in five of the large varieties would clearly detract from their widespread use (Plate 7). These were:

- Tom 12 (Golden Shine) – potential as a low acid yellow tomato with a different taste, but appeared prone to soft rots starting at the flower end of the fruit, thereby increasing harvest wastage and shortening storage life;
- Tom 17 (Tropic) – skin disfigured by scarring;
- Tom 19 (Beef Maestro) – basal splits radiating away from the fruit stalk;
- Tom 20 (Carmelita) – some fruit do not colour up properly when ripe, leaving large unattractive yellow-green areas on the skin; and
- Tom 21 (Celebration) – appreciably higher incidence of blossom end rot than other varieties.

However, this still leaves a large group of potentially useful new tomato varieties with varying uses. Children were attracted to the grape varieties and did not seem concerned by the sometimes tough thicker skin characteristic of grape tomatoes; they typically found the very sweet varieties, Tom 07 (Ruby) and Tom 27 (Sugar Plum), particularly attractive. Samples of each variety were assessed for cooking quality by a cooperating Asian delicatessen. The best varieties for this purpose were Tom 08 (Solar) and Tom 14 (Daran) because their tough skins and firm dense flesh enabled them to retain integrity under high temperature cooking (Vishwa Pilai, personal communication).

Among the melons, the standout groups were the smooth-skinned varieties with typical orange rockmelon flesh (Mel 13, Mel 14), particularly Papayadew which was invariably rated "outstanding" or "the best" for flavour, and the netted green-fleshed rockmelons (Mel 15, Mel 26, Mel 27, Mel 76) (Table 7; Plate 8). All of these varieties showed good disease resistance in Year 1, and were among the more productive melons in Year 2. Mel 06 (Lacus) looked the more promising of the two normal rockmelon varieties, courtesy of its thicker flesh and smaller seed cavity. The trial also identified a range of promising honeydew melons with white or orange flesh and different coloured rind in addition to the standard green fleshed honeydew types Mel 10, Mel 11 and Mel 12, though the last of these (Silver World) has a propensity to produce larger fruit (up to 3.5 kg in Year 1 and 2.8 kg in year 2) than would be acceptable on the Australian market.

**Table 6.** Productivity and fruit characteristics of tomatoes grown in Year 2 trials at Birkdale, QLD. Ratings: 1 = worst, 5 = best.

| Planting code | Variety name | Growth habit | Fruit class, size & shape | Fruit colour | Productivity rating | Flavour rating | Other comments |
|---|---|---|---|---|---|---|---|
| Tom 02 | Chica | I | Grape (oblong/elliptical) | Red | 4 | 3.7 | |
| Tom 03 | Floridity | I | Grape (oblong/pear) | Red | 5 | 4.0 | |
| Tom 05 | Golden Sweet | I | Grape (oblong/pear) | Yellow | 5 | 5.0 | |
| Tom 07 | Ruby | I | Grape (small globe) | Red | 5 | 5.0 | Very sweet |
| Tom 08 | Solar | I | Grape (large globe) | Red | 5 | 2.0 | Thick skin and firm fruit; good for cooking |
| Tom 09 | Rojita | I | Grape (oblong/plum) | Pink | 5 | 4.3 | |
| Tom 10 | Tropical Ruby | SD | Grape (oblong/plum) | Red | 5 | 2.7 | |
| Tom 12 | Golden Shine | I | Large smooth rounded | Yellow | 4.5 | 2.0 | Tendency for soft rot at flower end of the fruit |
| Tom 13 | Caracoli | I | Large smooth rounded to oval | Red | 5 | 2.7 | |
| Tom 14 | Daran | I | Medium smooth oblong | Red | 5 | 4.7 | Thick skin and firm fruit; good for cooking |
| Tom 15 | An67 (Mariner) | D | Medium smooth oblong | Red | 5 | 4.7 | |
| Tom 16 | Mongal (Patio Supreme) | D | Large smooth flattened rounded | Red | 5 | 4.7 | |
| Tom 17 | Tropic | SD | Large smooth rounded | Red | 4.5 | 4.0 | Scarring develops on skin of some fruit |
| Tom 18 | TyQueen | D | Large smooth rounded | Red | 5 | 4.3 | |
| Tom 19 | Beef Maestro | I | Large beefsteak | Red | 4.5 | 3.3 | Fruit develops basal splits away from the stalk |
| Tom 20 | Carmelita | I | Large smooth rounded | Red | 4.5 | 2.7 | Colours unevenly when ripe |
| Tom 21 | Celebration | D | Large smooth rounded | Red | 4 | 1.3 | High incidence of blossom end rot |
| Tom 27 | Sugar Plum | I | Grape (oblong/plum) | Red | 5 | 4.5 | Very sweet |

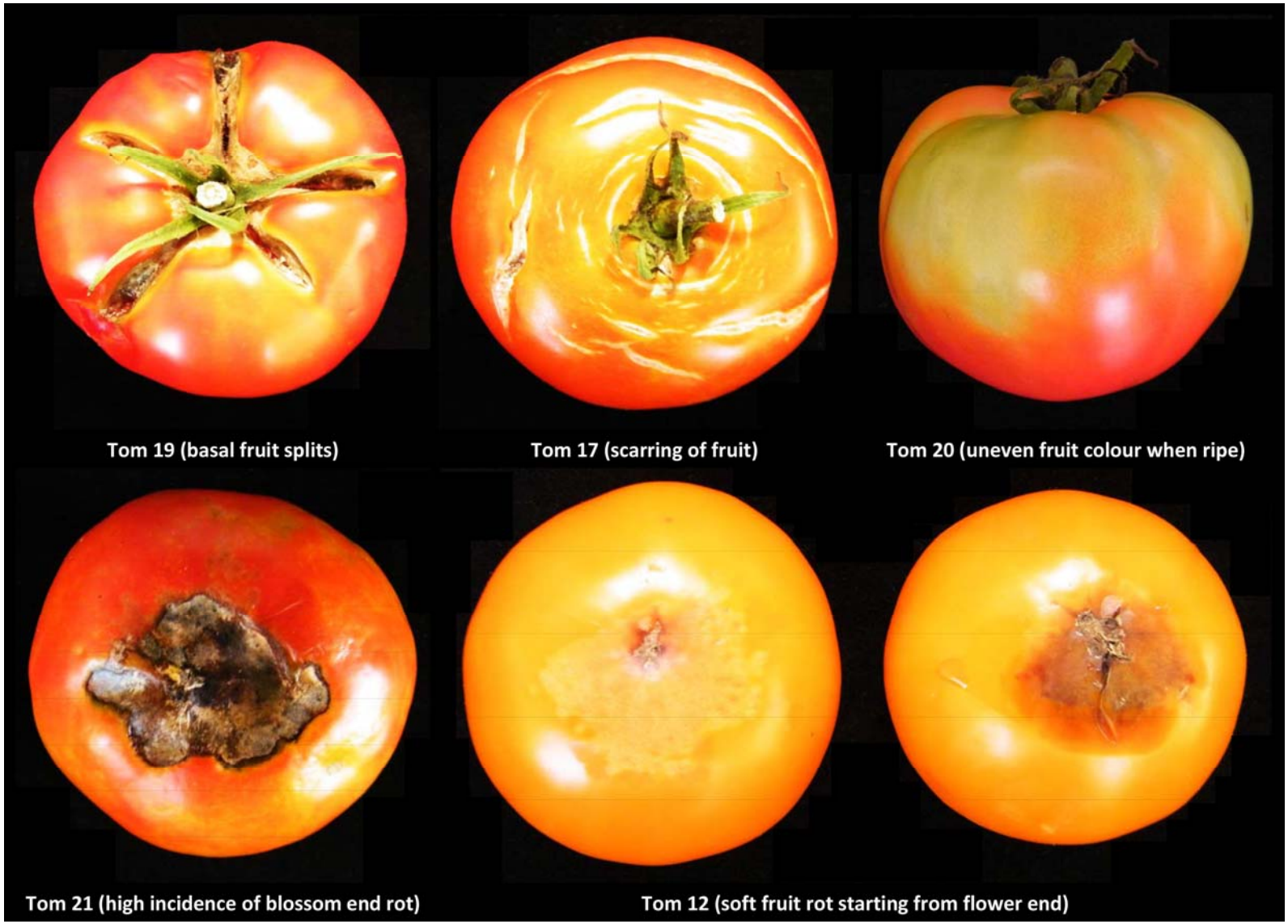


**Plate 7.** Fruit blemishes associated with specific varieties in Year 2 trials at Birkdale, QLD.

**Table 7.** Productivity and fruit characteristics of melons grown in Year 2 trials at Birkdale, QLD. Ratings: 1 = worst, 5 = best.

| Planting code | Variety name | Fruit per plot | | Average fruit weight (kg) | Maximum fruit weight (kg) | Eating quality rating | Other comments |
|---|---|---|---|---|---|---|---|
| | | Total (kg) | Total No. | | | | |
| Mel 05 | Red Aroma | 9.14 | 10.0 | 0.91 | 1.61 | 4.0 | Larger seed cavity than Mel 06 |
| Mel 06 | Lacus | 6.18 | 9.0 | 0.69 | 1.56 | 4.5 | Relatively small central seed cavity |
| Mel 10 | Honey World | 9.53 | 11.0 | 0.85 | 1.96 | 5.0 | Honeydew, smooth creamy skin with few nets; stores well |
| Mel 11 | Diosa | 7.12 | 11.0 | 0.65 | 1.45 | 5.0 | Honeydew, smooth creamy skin with few nets; stores well |
| Mel 12 | Silver World | 15.28 | 12.0 | 1.27 | 2.79 | 4.5 | Honeydew; smooth ivory skin; large fruit; stores well |
| Mel 13 | Red Queen | 6.76 | 10.0 | 0.67 | 2.05 | 5.0 | Smooth skin; traditional orange rockmelon flesh |
| Mel 14 | Papayadew | 10.26 | 10.0 | 1.03 | 1.93 | 5.0 | Smooth skin; traditional orange rockmelon flesh |
| Mel 15 | HT 6040 | 8.84 | 11.0 | 0.80 | 1.34 | 5.0 | Netted; paler green flesh than Mels 26, 27, 76 |
| Mel 16 | QY041 | 7.40 | 11.0 | 0.67 | 1.26 | 4.8 | Honeydew type; crisp pale orange flesh; smooth yellow outer skin |
| Mel 18 | PS040A | 8.23 | 9.0 | 0.91 | 2.02 | 5.0 | Honeydew type; pale green flesh; some netting on light green/white skin when ripe |
| Mel 20 | HM003 | 13.19 | 12.5 | 1.06 | 2.08 | 4.5 | Honeydew type; crisp white flesh; bright gold outer skin |
| Mel 22 | HM006 | 7.01 | 9.0 | 0.77 | 1.32 | 3.5 | Hami type; crisp pale orange flesh; netted yellow outer skin; oblong shape; prone to rotting in field |
| Mel 24 | Jin Rui | 15.68 | 14.0 | 1.14 | 1.86 | 5.0 | Honeydew type; crisp white flesh; smooth gold outerskin |
| Mel 26 | Alien | 11.12 | 10.0 | 1.11 | 2.19 | 5.0 | Netted; pale to mid-green flesh |
| Mel 27 | Arkanga | 18.35 | 23.5 | 0.78 | 1.52 | 5.0 | Netted; dark green flesh |
| Mel 76 | HM001 | 12.91 | 12.0 | 1.08 | 1.68 | 5.0 | Netted green skin; dark green flesh; stores well |
| ***LSD (P=0.05)*** | | ***4.92*** | ***3.0*** | ***0.35*** | *-* | *-* | *-* |


**Plate 8.** Internal fruit characteristics of shortlisted melon varieties in Year 2 trial.

The trial identified a promising group of small "icebox" watermelons – Mel 54 (Ring 601), Mel 55 (Ring 603) and Mel 65 (Typhoon) – with thin inner rinds, dense non-cracking flesh and outstanding flavour. Although these did not crop as heavily as some of the large watermelons, this should balance out to a considerable extent in denser paddock plantings of their smaller vines. A number of the other smallish melons trialled also showed similar characteristics (e.g. Mel 31, Mel 35, Mel 36, Mel 38, Mel 61, Mel 66, Mel 69, Mel 72), though not quite as outstanding. Among the yellow-fleshed watermelons not currently represented on the Australian market, Mel 41 (Sureness) was outstanding. All of the smaller so-called seedless varieties actually set numerous rudimentary partially-developed seeds. However, there are also some larger seeded and seedless melons (e.g. Mel 67, Mel 50, Mel 51) that also warrant further trialling and possible commercialisation.

**Table 8.** Productivity and fruit characteristics of watermelons grown in Year 2 trials at Birkdale, QLD. Ratings: 1 = worst, 5 = best.

| Planting code | Variety name | Fruit per plot | | Average fruit weight (kg) | Maximum fruit weight (kg) | Eating quality rating | Other comments |
|---|---|---|---|---|---|---|---|
| | | Total (kg) | Total number | | | | |
| Mel 31 | Bright Gem | 21.39 | 4.5 | 4.77 | 7.50 | 5.0 | Very thin inner rind |
| Mel 35 | Showing | 16.12 | 7.0 | 2.30 | 3.78 | 4.8 | Very thin inner rind |
| Mel 36 | Southern Light | 22.90 | 8.0 | 2.86 | 6.10 | 4.8 | |
| Mel 37 | Famed Lady | 18.59 | 6.0 | 2.90 | 6.50 | 4.0 | |
| Mel 38 | Sweet Beauty | 21.42 | 8.0 | 2.63 | 9.64 | 4.8 | |
| Mel 41 | Sureness | 20.32 | 6.5 | 3.30 | 5.31 | 5.0 | Very thin inner rind |
| Mel 42 | Diana | 14.39 | 10.0 | 1.45 | 2.85 | 4.5 | |
| Mel 44 | New Orchid | 17.62 | 7.5 | 2.36 | 3.61 | 4.5 | |
| Mel 48 | Gentility | 13.62 | 6.5 | 2.10 | 3.91 | 4.5 | Seedless; numerous rudimentary white seeds, central crack |
| Mel 50 | Felicity | 39.63 | 7.0 | 5.45 | 11.50 | 5.0 | Seedless, very few rudimentary white seeds |
| Mel 51 | Orchid Sweet | 21.20 | 5.0 | 4.24 | 6.40 | 5.0 | "Seedless"; numerous rudimentary white & brown seeds |
| Mel 52 | Prosperity | 37.59 | 8.0 | 4.73 | 9.50 | 5.0 | "Seedless"; numerous rudimentary white & brown seeds |
| Mel 53 | Farmers Wonderful | 11.31 | 3.5 | 3.38 | 4.45 | 4.5 | Seedless, few rudimentary white seeds |
| Mel 54 | Ring 601 | 15.54 | 8.0 | 1.94 | 3.91 | 5.0 | Very thin inner rind, dense flesh, no central cracking |
| Mel 55 | Ring 603 | 13.69 | 6.0 | 2.25 | 4.20 | 5.0 | Very thin inner rind, dense flesh, no central cracking |
| Mel 61 | PS036 | 22.71 | 6.5 | 3.45 | 6.10 | 4.8 | |
| Mel 63 | Golden Sun | 15.52 | 11.0 | 1.41 | 2.60 | 4.5 | Fruit tends to split following rain |
| Mel 65 | Typhoon | 14.00 | 8.5 | 1.61 | 5.32 | 5.0 | Very thin inner rind, dense flesh, no central cracking |
| Mel 66 | #555 | 16.05 | 9.0 | 1.73 | 7.00 | 4.5 | Very thin inner rind, soft outer rind |
| Mel 67 | Baby Dragon 2 | 19.53 | 5.0 | 4.43 | 10.10 | 4.8 | |
| Mel 68 | Dark Belle | 7.14 | 3.5 | 1.97 | 4.04 | 4.8 | Thin inner rind |
| Mel 69 | Dark Dragon | 11.78 | 5.0 | 2.33 | 3.41 | 4.8 | Thin inner rind |
| Mel 72 | New Belle | 18.98 | 7.5 | 2.51 | 4.85 | 4.8 | |
| ***LSD (P=0.05)*** | | ***13.93*** | ***3.7*** | ***1.78*** | - | - | - |


**Plate 9.** Internal fruit characteristics of shortlisted watermelon varieties (except for Mel 63) in Year 2 trial.

# DISCUSSION

The trial data reported here clearly demonstrates the value of running local variety trials before committing to the large-scale import of seed of new vegetable varieties. In the case of the melon varieties trialled, apparent differences in disease resistance between Asia and Australia caused around 40% of varieties to fail. Worldwide, powdery mildew is a serious disease of melons, with >20 different races identified (McCreight 2006; Kuzuya et al. 2006). In other cases where there is no evidence of any causal disease, other crops (e.g. watermelons, tomatoes) may still fail to perform as well in a new country and a new environment simply because of poor adaptation or perhaps some genetic weakness leading to the tomato fruit blemishes noted in the Year 2 trials.

At the same time, trials on new varieties bred overseas can identify promising lines of breeding not currently represented (or not well represented) on the market. For example, grape tomato varieties were first developed in Southeast Asia, and introduced worldwide in the 1990s; they typically produce small, sweet, oblong fruits as shown in Table 2 and Plate 1, and tend to produce thicker skins (as noted in the Highsun taste tests – Table 3) and are less watery than cherry tomatoes making them easier to handle. Australia probably has a shorter history of their use than other western countries, as there was no mention of grape tomatoes in a comprehensive AgriLink article on tomato production by Fullelove et al. (1998). The use and popularity of grape tomatoes nowadays is increasing, but there is still plenty of scope for their further promotion as a healthy alternative in the likes of school lunches (snackbox tomatoes, lunchbox tomatoes?) and plenty of varieties suitable for growing here.

Similarly, small “icebox” melons are a more user-friendly product, taking up less space in the family refrigerator than the traditional large watermelons. In our experience, almost everyone who tries a good yellow-fleshed watermelon likes their different, more delicate flavour, so the lack of take-up of this type of watermelon in Australia seems to have been a simple case of lack of opportunity and lack of exposure.

However, it is the melons that demonstrated the widest range of missed opportunities. Given the similarity (and superior flavour) of its orange flesh to that of our standard rockmelon, the smooth-skinned Papayadew, for example, should be relatively easy to promote market acceptance. However, the netted green-fleshed rockmelons (sometimes called Galia melons after the first cultivar developed in Israel from a cross between the green flesh melon cultivar ‘Ha-Ogen’ and the netted rind melon cultivar ‘Krimka’ and released in 1973 - Karchi 2000) are really a new product that will take more persistence and promotion to market. Despite their slightly later maturity than the orange-fleshed types, the green rockmelons show a number of distinct advantages over the traditional rockmelon:

- Appreciably earlier development of good flavour during the ripening process;
- Crisp sweet green flesh; and
- Considerably longer lasting in storage to reduce wastage of fruit, which should be something that appeals to the average fruit retailer.

# RECOMMENDATIONS

It is recommended that local variety trials be conducted to determine their environmental adaptation, including disease resistance, before committing to the large-scale import of seed of new fruit and vegetable varieties to Australia.

It is further recommended that continuing research and promotion be directed to facilitate the adoption, or wider adoption, of the following novel fruit types new to Australian producers and consumers:

- Small ‘icebox’ watermelons;
- Yellow-fleshed watermelons with different and more delicate flavour than the traditional red watermelons;
- Honeydew melons with white or orange flesh as alternatives to the standard green honeydews; and
- Green-fleshed “Galia” rockmelons with earlier and more reliable flavour development and longer-lasting in storage than the traditional orange-fleshed rockmelon.

# TECHNOLOGY TRANSFER

The main avenue for technology transfer in relation to the new and novel varieties identified in this project will be commercialisation through Highsun Express Plugs. The tomatoes, with existing markets, albeit small for some types, should be relatively easy, but import requirements for disease freedom on imported seed and the price of seed could still change the actual varietal mix imported.

The company is currently attempting to source larger quantities of seed of Papayadew melon, some of the novel honeydews and 'icebox' melons for larger-scale trialling with selected growers, independent fruit shops and processors.

However, the more novel yellow watermelons and green-fleshed rockmelons are expected to take longer to introduce to the market through the same processes and route.

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# APPENDIX 1: Asian Seed Congress

The Asia and Pacific Seed Association (APSA) was established in 1994 to promote quality seed production and marketing in the Asia and Pacific Region. The initial impetus was provided by the Food and Agriculture Organization of the United Nations (FAO) with initial funding support from DANIDA. By the late 1990s, APSA had grown to the point where it was self-sustaining through its own financial resources. Today, APSA is the largest regional seed association in the world. APSA members include national seed associations, government agencies, public and private seed companies, and associate members (mainly from the US).

APSA hosted the first Asian Seed Congress in late 1994. Nowadays, the annual Asian Seed Congress provides an opportunity for face-to-face contact with seed companies (particularly vegetable suppliers) from all parts of the region from the Middle East through to USA; and many of the attendees come specifically for the trading opportunities facilitated through what has become a major trading event in the seed world.

Asian Seed 2011 was held in Kaohsiung, Taiwan from 9-12 November 2011. Asian Seed 2011 was attended by 922 registrants from 42 countries. There were 70 commercial displays (e.g. Plate 9) and 112 trading tables (Plate 10). This event provided a unique opportunity for the project leader to interact with vegetable seed supply companies located in the northern hemisphere at subtropical and tropical latitudes as well as others from more traditional temperate climates. Most of the Taiwanese seed companies displaying their products at Asian Seed 2011 had not attended and/or mounted a display at previous Asian Seed Congresses. The international Asian Vegetable R&D Center is located nearby in Tainan, and breeding work by AVRDC provides impetus and part-finished breeding material for the many vegetable seed companies located there and throughout the Southeast Asian region.

By attending Asian Seed 2011, seed samples of almost 20 varieties of tomatoes, nearly 30 varieties of melons, and more than 30 watermelon varieties were eventually obtained for trialling in this project from seed companies located in Taiwan, Vietnam, Peoples Republic of China and USA.


**Plate 10.** Display by Known-You Seed Co., Ltd. – one of 70 commercial exhibits at Asian Seed 2011.

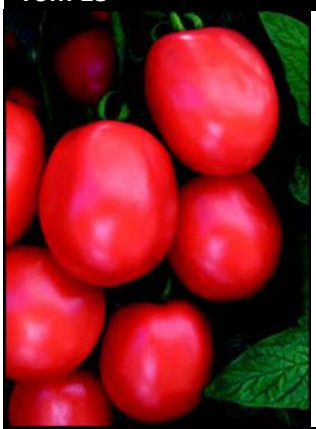

**Plate 11.** View across some of the 112 trading tables at Asian Seed 2011.

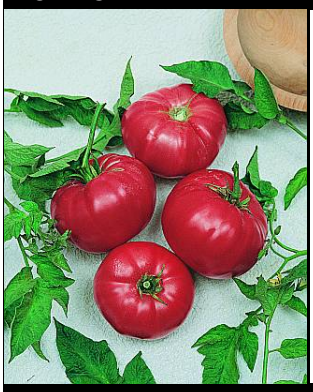
# APPENDIX 2: Tomato Varieties in Trials

The following varietal descriptions and photographs have been obtained from seed company catalogues and websites.

| | |
|---|---|
| **Tom 01** | **Aria** |
|  | This semi-determinate and heat-tolerant variety is early and can be harvested around 70-80 days after sowing. The oblong shaped fruit is golden colour, firm, and delicious. It weighs around 13-15 g, with sugar content of around 9.5%, and has few cracking fruits. |
| **Tom 02** | **Chica** |
|  | Plant is indeterminate and very early. The bright red fruit is oblong and firm, and not easy to crack, good for shipping and storage., weighing around 19 g. It can be harvested around 75 days after harvesting. The taste of the fruit is sweet (brix is around 8.6%) and delicious. |
| **Tom 03** | **Floridity** |
|  | Plant is early, indeterminate, tolerant to *Fusarium* wilt Race 1 and CMV. Fruit is shiny red, oblong shaped, around 17 g in weight and contains very few seeds inside. The sugar content can be up to 9.3% on brix with excellent flavour. It is firm, good for shipping and seldom cracks. It can be harvested about 84 days after sowing. |
| **Tom 04** | **Golden Gem** |
|  | Plants are tall with dark green, slightly curled leaves. Early, can be harvested about 75 days after sowing. Very prolific with about 16-70 fruits per cluster. Double-stem pruning can produce over 500 fruits in one plant. Fruit is round to slightly globe-shaped, and has a stunning orange skin colour. It is sweet with sugar content of up to 10%, firm against cracking, and weighs approximately 16 g. This cultivar is ideal for growing in spring and autumn in tropical and subtropical regions. |
| **Tom 05** | **Golden Sweet** |
|  | Plant is indeterminate and vigorous. The orange yellow fruit is elongated and firm, not easy to crack, good for shipping and storage, weighing about 15 g. It can be harvested around 80 days after sowing. The taste of fruit is sweet (brix is about 9.3%) and delicious. |

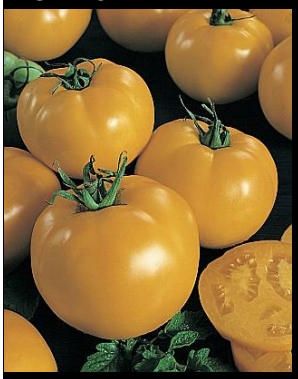
| Tom 06 | Orito |
|---|---|
| Not available | No description available |
| **Tom 07** | **Ruby** |
|  | Mini fruit shape and globe shape. The average weight is about 9 grams with light green shoulder. Sugar content can reach 10.6% with resistance to *Fusarium* Wilt R1.It takes about 75 days from sowing to harvesting. Very strong flavour |
| **Tom 08** | **Solar** |
|  | This indeterminate variety can be harvested by cluster. The deep red fruit is globe, firm and not easy to crack, weighing around 39 g. Its sugar content is about 6%. It can be harvested around 81 days after sowing. |
| **Tom 09** | **Rojita** |
|  | Plant is indeterminate and sets fruit early. The pinky fruit is oblong and uniform, weighing around 20 g. It can be harvested around 85 days after sowing. The taste of fruit is sweet (brix can be up to 10%) and delicious. |
| **Tom 10** | **Tropical Ruby** |
|  | Plant is semi determinate, tolerant to heat, humidity, and *Fusarium* wilt race 1. The fruit is oblong shaped, around 13 g in weight. It is uniformly bright red, sweet (up to 8.5% sugar content) with excellent flavour. Its firm texture allows shipping. Some plants might occasionally retard and not bear fruit due to hereditary genes and climatic conditions. |
| **Tom 11** | **Grace** |
|  | Plants are indeterminate, vigorous, with good foliage covering. Resistant to sunburn. Fruit is globe to deep globe-shaped with pink skin when mature. Very Firm, weighing 250-300 g. It can be harvested within 100 days after sowing. This hybrid is considered a very desirable and marketable variety because of its colour. |

| Tom 12 | Golden Shine |
|---|---|
|  | Indeterminate. It has 4-6 fruit in each cluster, when matured, the fruit is orange-yellow and bright in colour. The fruit shape is round, full and beautiful, tolerant to cracking, and has good flavour. It is about 160-200 grams in weight. |
| **Tom 13** | **Caracoli** |
|  | Hybrid indeterminate variety suitable for staked production. Fruits are round to oval, very big size, 170 to 200 g weight. Uniform colour. Maturity: early - 70 to 80 days from transplant. Harvest: spread over 4 to 5 weeks. Very productive variety. Resistant to heat .Tolerance: Bacterial wilt (*Ralstonia solanacearum*), *Fusarium* sp., *Stemphylium*. |
| **Tom 14** | **Daran** |
|  | Hybrid variety suitable for a wide range of growing conditions. Grows strongly with a vigorous foliage. Semi-determinate growth. Maturity: 65-70 days after transplant. Harvesting period lasts more than 45 days, depending on plant conditions. Plants bear many fruits in clusters with the following features : oblong shape, medium size, uniform colour, weighing 100 - 110 g per fruit, thick, hard fruit (good for transportation), long shelf life. High tolerance to *Fusarium* O, *Pseudomonas*, *Stemphylium*, *Verticillium*, TYLCV and nematodes and heat. |
| **Tom 15** | **Mariner (AN-67)** |
|  | Determinate plant growth with high fruit setting. Maturity: 65-68 days after transplant. Fruits are egg-shaped, uniform colour, and weight 110-120 gram (0.25 lb) each. Tolerant to nematodes and TYLCV /WTG (whitefly-transmitted geminivirus conditioned by the Ty-2 gene from H24), BW (bacterial wilt), TMV (tomato mosaic virus conditioned by the Tm2a allele), F-1 (*Fusarium* wilt race 1) and Sm (gray leaf spot –*Stemphyllium*). |
| **Tom 16** | **Mongal (T-11)** |
|  | F1 T-011 is very well adapted to hot and tropical conditions. Determinate growth. Flowers blossom after 23-27 days from transplant. Maturity: 60 - 65 days after transplant and harvest lasts 25- 30 days. Heavy yields, round and flat-shaped fruits with green shoulder before maturity and bright red colour at maturity, average weight: 140-160 g per fruit with good firmness. F1 T-09 displays both high heat tolerance and good resistance to diseases, especially bacterial wilt, *Fusarium*, *Verticillium*, and powdery mildew. |

| Tom 17 | Tropic |
|---|---|
|  | Semi-determinate variety with 200-220 gram fruits, F1 Tropic is very well adapted to hot and tropical conditions. Maturity: 70 days after transplant. Heavy yields, fruits are bright red colour at maturity, average weight: 200-220 g per fruit with good firmness. F1 TROPIC displays both high heat tolerance and good resistance to diseases, especially bacterial wilt, *Fusarium*, *Verticillium*, and powdery mildew. |
| **Tom 18** | **TyQueen** |
|  | Determinate growth, round fruits with red colour, extended shelf life, and weight of 180-200 g. Maturity: 68-70 days after transplanting. TyQueen shows excellent tolerance to Heat and Cold, WTG (whitefly-transmitted geminivirus conditioned by the Ty-2 gene from H24), BW (bacterial wilt), TMV (tomato mosaic virus conditioned by the Tm2a allele), F-1 (*Fusarium* wilt race 1), Sm (gray leaf spot - *Stemphyllium*) and nematodes. The resistance to geminiviruses is excellent (DSI = 1). |
| **Tom 19** | **Beef Maestro** |
|  | With deep oblate, extremely large red fruit, Beef Maestro F1 weighs an average of 14 ounces. This is an indeterminate plant. A tasty extra large beefsteak comparable to Beefmaster F1 |
| **Tom 20** | **Carmelita** |
|  | Indeterminate plant which produces flat deep oblated 8 ounce pink/red fruits with excellent flavour. Pedigree is based in Freight heirloom varieties. Very tasty. |

| Tom 21 | Celebration |
|---|---|
|  | An adaptable vigorous determinate tomato that is great for the commercial or home garden markets. Celebration F1 is a large red deep oblate fruit, usually having an average weight of 8 ounces. Disease resistant. Fruit are very uniform and are high quality. |
| **Tom 22** | **Honeybee** |
|  | Exceptionally sweet, round bright yellow cherry tomato has a 1-inch diameter. This semi-vining tomato can literally have dozens of delicious ripe fruit set on its multiple branch clusters. Perfect for adding colour to your salads. |
| **Tom 23** | **Ladybug** |
|  | Intermediate plant habit, 1 ounce red cherry tomatoes have excellent flavour, very sweet. Crack Resistant, widely adapted. |
| **Tom 24** | **Monarch** |
|  | Hybrid orange cherry, indeterminate plant sets fruit in clusters. Very sweet. Nice colour to package with red and yellow cherry tomatoes in clam shells. |
| **Tom 25** | **Orange Pixie** |
|  | A delicious dwarf determinate tomato with rugoso leaves, Orange Pixie F1 is an excellent choice for growing in containers and patio gardens. This deep oblate golden orange fruit weighs 4 ounces. Resistant to ASC, F1, ST. |

**Tom 26** **Sunny Boy**



Bright yellow 6 ounce fruits with few seeds. Very sweet flavour, fruits are globe shaped and firm plus will ship well. Determinate plants sets well in many conditions.

**Tom 27** **Sugar Plum**

Hybrid "grape" tomato. Indeterminate, very heavy yielding, 3/4 - 1 inch red plum shaped, very sweet and tasty fruit. Sets in clusters.

**Tom 28** **Tastemaster**

This delicious pink tomato with green shoulders is on an indeterminate vine. This sweet, succulent deep oblate tomato offers outstanding flavour in its 7-ounce fruit. With multiple disease resistance, Tastemaster F1 is perfect for home gardeners looking for a flavourful addition to their garden

**Tom 29** **Sweet Cherry**

Indeterminate plant, height dependent upon when you pinch out growing points. It will grow up to 10 metres if not pinched. Fruits large clusters, excellent flavour, average fruit size 20g.

**Tom 30** **Super Prize**

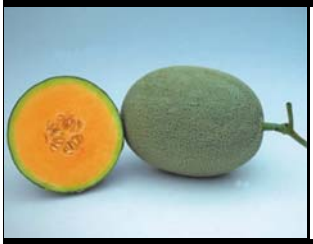
Super Prize is an F1 hybrid of determinate parents that grows to 0.5 metres. It is an improved version of First Prize, showing disease resistance to *Verticillium* Wilt and *Fusarium* Wilt. It's a mid to late crop with 2-5cm globular fruits. An ideal balcony crop for container vegetable gardening.

| Tom 31 | Kaluha (Brown Cocktail) |
|---|---|
|  | Brown fruit is formed on long trusses of 8-10 and weighs 40-50g. Bush is indeterminate and can fruit over a long period. Very high in lycopene. Resistance: Tomato Mosaic Virus, Verticillium Wilt, Fusarium Wilt races 0, 1 and 2 and Nematodes. |
| **Tom 32** | **Sacher (Brown Gourmet)** |
|   | PLANT: Indeterminate Special Tomato. Vigorous. Very early. ToMV, Ve, F 0-1-2, N resistant.<br><br>FRUIT: Brownish red colour. 5-7 fruits on cluster. 150 g. Firm and quality. Long Shelf Lıfe. Perfect taste and aroma.<br><br>CULTIVATION: Spring and Autumn in greenhouse. |
| **Tom 33** | **Zola** |
|  | A firm fruited variety with Nematode and Bacterial Wilt resistance. Attractive, good flavoured fruit. Maturity from transplant: 10 – 12 weeks. Fruit type: Round, red, jointed. 140 – 150g. Plant habit: Semi-determinate, requires trellising. Disease Resistance: V, F2, N, BW. Zola is a variety developed by Yates. It has large red fruit 10-14cm the tall bush, highly productive and wilt resistant. |

# APPENDIX 3: Melon Varieties in Trials

The following descriptions and photographs have been obtained from seed company catalogues and websites.

| Mel 01 | Amy |
|---|---|
|   | The winner of All American Selection. Plant is medium vigorous, and has strong fruit-setting. Fruit is deep globe in shape with smooth yellow rind, but occasionally few netted. Fruit weighs about 1.5-2.0 kg with tender white flesh, and has sugar content of around 15%. It can be harvested around 70-85 days after sowing. |
| **Mel 02** | **Sophy** |
|   | This variety has many female flowers and sets fruit well. Fruit is global in shape, weighs about 1.8kg, and has gray-green rind with medium dense nets. The flesh is light green, soft and juicy. The sugar content is 14-16% on Brix. It can be harvested 55-60 days after flowering and fruit does not slip off, nor change colour when ripens. Ships and stores well. This Deluxe melon performs well with vertical cultivation in greenhouse. |
| **Mel 03** | **Angel** |
|   | Fruit is globe to short-oblong in shape, yellow-green rind with few nets and weighs about 0.8-1.2kg. The flesh is pale green, soft and sweet with sugar content about 16-19% on Brix. Fruit does not slip off. It can be harvested 30-35 days after flowering. Open-field cultivation can be practiced well on this All America Selections Winner variety |
| **Mel 04** | **Emerald Sweet** |
|   | This netted variety is a very sweet and tough shipper. The fruit is in tall globe shape and weighs about 1.3-2.0 kg. The flesh is green and tender with sugar content of 14-18%. It has a delicious taste with excellent flavour. The fruit is fully developed 40-45 days after flowering. Fruit may be picked a few days before fully mature, allowing 2-3 days for after-harvest ripening. Good for long-distance shipping. |
| **Mel 05** | **Red Aroma** |
|  | Plant is medium vigorous, and has good fruit setting. The fruit is deep globe shaped, and its rind is grey-green with stable nets. Fruit weighs around 2.1 kg. The thick dark orange flesh with soft texture has good aroma and high sugar content of 15-18%. It can be harvested around 75-90 days after sowing, and is good for shipping and storage. Resistant to Fusarium Race 0 and Race 2. |

| Mel 06 | Lacus |
|---|---|
|  | The fruit is deep globe in shape, orange rind with thick and dense nets. Fruit weighs around 1.8-2.5 kg, with orange flesh and has sugar content of 12%. It can be harvested around 70-80 days after sowing. Resistant to Fusarium Race 0, Race 2 and powdery mildew. |
| **Mel 07** | **Dignity** |
|  | Plant has good coverage. The fruit is short-oblong in shape, orange-yellow rind with thick and dense nets. Fruit weighs around 2.0-2.5 kg, with orange flesh and has sugar content of 11-14%. It can be harvested around 70-80 days after sowing. Resistant to *Fusarium* Race 2 and powdery mildew. |
| **Mel 08** | **Bright Century** |
|  | This is an improved hybrid of Chinese Hami melon. The plant is vigorous and has excellent fruit-setting. The fruit is oblong in shape, grey-green rind with dense nets. Fruit weighs around 2.7-3.5 kg. The thick red-orange flesh with crispy and delicious texture has sugar content of 13-16%. Fruit can be harvested around 85-100 days after sowing, and is good for shipping and storage. Resistant to *Fusarium* Race 2. |
| **Mel 09** | **Golden Lady** |
|  | An early, medium-sized, and yellow skinned variety. It is round to oval-shaped with silky skin and a small blossom end. It matures 35 days after flowering when the fruit skin turns yellow. Weight is about 1-1.5 kg. It has white flesh, good flavour, and is not easy to ferment. Suitable for storage and shipping. |
| **Mel 10** | **Honey World** |
|  | This Honey Dew hybrid melon is early, slightly oblong, and with smooth creamy-white skin which may have few nets occasionally. Flesh is light green, tender, and sweet with sugar content about 14-16%. Fruit usually ripens about 45-55 days after flowering and weighs about 1.7-2.5 kg. Does not slip off easily and good for storage and shipping. |
| **Mel 11** | **Diosa** |
|  | This variety is earlier than Honey World. Fruit is about 1.5-2.0 kg, with smooth white skin that may have few nets occasionally. Flesh is tender and sweet with sugar content around 14-16%. It can be harvested around 40-45 days after flowering. Good for storage and shipping. |

| Mel 12 | Silver World |
|---|---|
|  | A sister variety of Honey World, but earlier and more vigorous. Plant has good foliage cover and resistance against *Fusarium* Race 2. Fruit is globe-shaped with smooth ivory skin, and weighing around 1.5 kg. Flesh is light green, tender, sweet, and has good flavour. Sugar content is around 14-16%. Recommended to pick before half-slip stage for better shelf life. |
| **Mel 13** | **Red Queen** |
|  | Rind is smooth, creamy-yellow when ripe. The light orange flesh has a distinct, sweet, juicy, and appetizing flavour and has high sugar content. Fruit is nearly round, about 1.0 kg. Vines are shorter than other melons, thus allow closer spacing. Recommended for home gardeners. |
| **Mel 14** | **Papayadew** |
|  | Looks like a honeydew, tastes like a cantaloupe. The melon was named Papayadew because the outside of it resembles a honeydew melon and the inside colour is orange like a papaya. Its texture is not as soft as a cantaloupe, and it's a more aromatic fruit. |
| **Mel 15** | **HT 6040** |
| **Not available** | No description available |
| **Mel 16** | **QY041** |
|  | Mid-early maturing variety, long round shape, golden yellow rind. Orange flesh, 4.2 cm thick, sugar content about 15-16%. Average weight is 1.5-2.5 kg, hard rind, suitable for storage and long distance transportation. |
| **Mel 17** | **PS040** |
|  | Early maturity, fruit set easy, round shape, white rind with green flesh, taste juicy, sugar content 14%, fruit weight is 1.2-1.5 kg. |

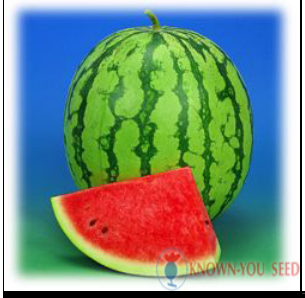
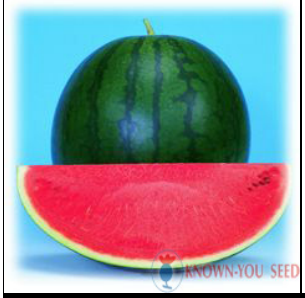
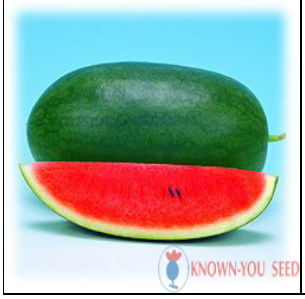
| Mel 18 | PS040A |
|---|---|
|  | Mid-early maturity, fruit set easy, white rind with green flesh, taste juicy, sugar content 15-17%, fruit weight is 2.0-3.0 kg, suitable for protective and open field. |
| **Mel 19** | **HM002** |
|  | Early maturation melon, 35 days harvest after flowering, plant vigorous, yellow rind with light orange-red flesh, taste excellent, sugar content 15-16%, 1.5-2.0 kg fruit, , good shipping. |
| **Mel 20** | **HM003** |
|  | Early maturation melon, plant vigorous, yellow rind with white flesh, taste excellent, sugar content 16-17%, 1.5-2.0 kg fruit, , good shipping. Tolerant to high and low temperature, suitable for protective and open field. |
| **Mel 21** | **HM005** |
|  | Mid-maturity, oblong shape, yellow rind with orange-red flesh, 3-4 kg/fruit. |
| **Mel 22** | **HM006** |
|  | Mid-maturity, oblong shape, yellow rind with orange-red flesh, 2.5 kg/fruit. |
| **Mel 23** | **Sunshine** |
|  | An early-medium variety with 35 days of fruit development. The ripe golden fruit has light orange flesh, approximate 3.5 cm wall thickness, 15.0% sugar content, 1.4-2.3 kg average weight. Rough and tenacious rind and supreme tolerance to shipment. |

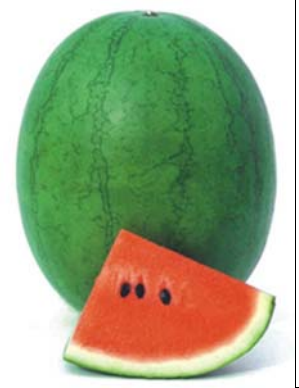
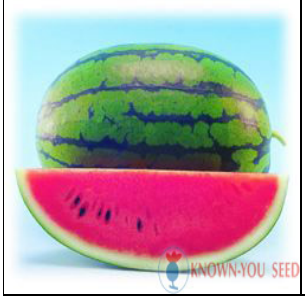
| Mel 24 | Jin Rui |
|---|---|
|  | Early maturity with 33-36 days of fruit development. Large fruit with good quality. Smooth and shiny golden rind. Fine-textured snowy white flesh, 4.0-4.4 cm wall thickness. It tastes succulent and sweet with 15-17% sugar content. Average weight approximate 1.5-1.8 kg. Tenacious rind, tolerance to shipment. |
| **Mel 25** | **Grand Golden Sweet** |
|  | Early maturity with 24-26 days of fruit development. New hybrid variety, oval shape, golden colour. Easy fruit setting with average 4 fruits on each plant. White flesh, approximate 3.0 cm wall thickness, 14-16% sugar content. Average weight 1-1.5 kg. |
| **Mel 26** | **Alien** |
|  <br>  | Very vigorous hybrid variety, tolerant to both powdery and downy mildew. F1 Alien is prolific, medium-early, can be harvested within 45-50 days after flowering (around 90 days after sowing). Fruits are round, with green skin and netting, weighing about 1.2 - 1.3 kg (2.7 lb). Flesh is green, juicy and sweet. |
| **Mel 27** | **Arkanga** |
|  <br>  | F1 Arkanga is a new hybrid melon variety with an excellent potential. It has proved itself during recent trials in greenhouses in Mediterranean areas as well as in outdoor cultivation trials in Asia and Middle East. Fruits have a netted skin, light green crispy flesh and weight approximately 1.5 kg (3.3 lb) each. F1 Arkanga provides very high yields and shows strong tolerance to *Fusarium oxysporum* strains 0, 1. |

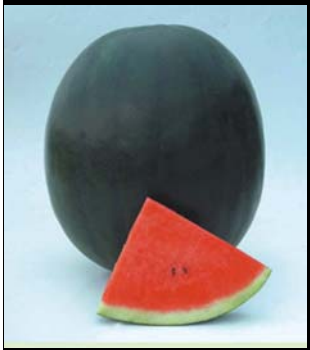
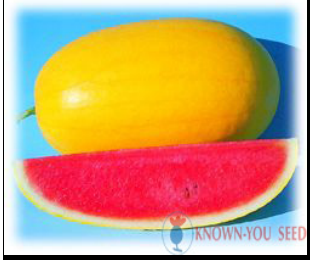
| Mel 28 | Supra |
|---|---|
|  | Very vigorous and tolerant (*Fusarium*, DM, PM) hybrid variety. Medium-early maturity (90 days from sowing). F1 Supra sets fruits easily and is very prolific. White smooth rind. Fruits are slightly oblong, weigh around 1-1.5 kg (2-3 lb.). Flesh is creamy-white colour and very sweet (14-17% sugar content). It is very juicy, tender and has a strong aroma. Very good shipper, easy to grow. |
| **Mel 29** | **Planters Jumbo** |
|  <br>  | Large oval shaped fruit ribbed on the outer surface with a deep reddish orange sweet-tasting flesh and an intense flavour. It is an early maturing vine that is resistant to diseases and rot. It does well in both dry and in wet areas. The fruit can grow up to 18 cm in diameter, and take 100-110 days to ripen. They have a moderate sized seed cavity and good sugar content. |
| **Mel 30** | **HM001** |
|  | Netted type melon, green rind with thick netting, round shape with green flesh.1.5-2.0 kg fruit. Long shelf life, good shipping. |

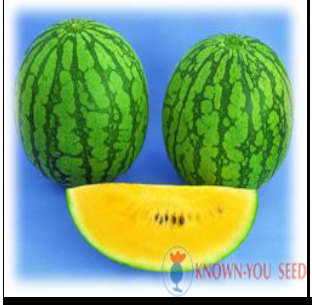
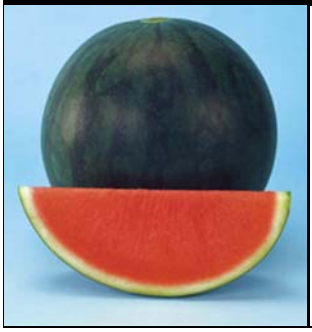
# APPENDIX 4: Watermelon Varieties in Trials

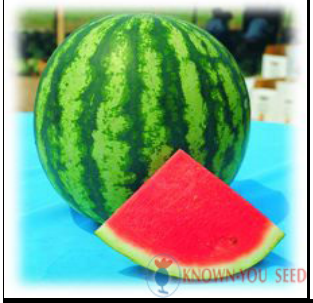
The following descriptions and photographs have been obtained from seed company catalogues and websites.

| Mel 30 | Flower Dragon |
|---|---|
|  | This hybrid is a characteristic variety for home gardens and local markets due to its early maturity and excellent quality. Its shorter vines allow closer spacing. Tolerant to CMV and good for shipment. |
| **Mel 31** | **Bright Gem** |
|  | This vigorous, medium-early F1 hybrid has stable productivity. The fruit is about 8 kg, and is less prone to hollow heart. Flesh is sweet, tasty, with attractive red colour. The rind is thin, but strong against cracking. Good for long-distance shipping. |
| **Mel 32** | **Fine Light** |
|  | This hybrid is medium-early, widely adapted, and has dependable fruit-set. Fruit is round, with green rind and dark green stripes, and weighs around 6 kg. Flesh is rosy-red, crisp, juicy, and sweet. A good shipper, very productive, and reliable. |
| **Mel 33** | **Cathay Belle** |
|  | This novel variety has attractive appearance and flesh quality similar to large-sized watermelon. It has wide adaptability and can be grown all year-round in Taiwan. Fruit is round with broad dark stripes scattered on the green rind. Weighs 3-4 kg with average sugar content of 12%. Rind is thin but tough. The fruit grows rapidly and seldom has hollow heart even under high temperature cultivation. |
| **Mel 34** | **Dark Belle** |
|  | Extra early, vigorous, elongated dark green fruit with indistinct dark stripes. Rind is thin but very tough, making the fruit a good shipper. Sugar content is around 12-14%. The fruit weighs between 2.5 and 3.5 kg. This variety performs even better in hot and dry seasons and adaptable to all types of soil. |

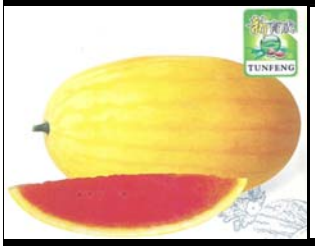
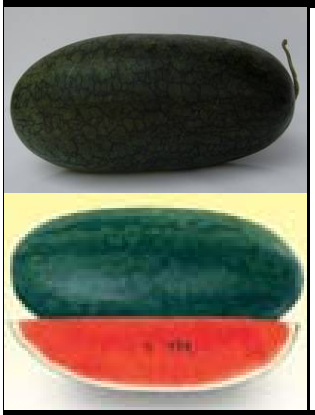
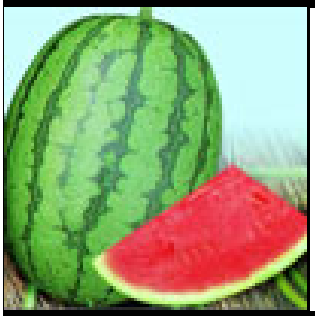
| Mel 35 | Showing |
|---|---|
|  | Early, vigorous, and prolific. Fruit is slightly oblong, weighing 2-3 kg. Rind is light green with bluish-black stripes, thin and tough. Flesh is dark red, tender and juicy with about 11% sugar content. It is a good shipper and stores well. This variety tolerates wet weather conditions and can perform better than other varieties in the rainy season. |
| **Mel 36** | **Southern Light** |
|  | Vigorous, early, easy fruit-setting, and productive. Its larger leaves protect the fruit from sunburn. Fruit is round with a dark green surface and stripes, and weighs 4-6 kg. Rind is thin but tough and flesh is red, sweet, and tasty. Good for storage and shipping. |
| **Mel 37** | **Famed Lady** |
|  | A small-sized Charleston Grey variety with uniformity and excellent shipping capability. Famed Lady has a strong vine, which gives good fruit protection and supports high yield. It can be harvested as early as 74 days after sowing and grow to about 4 kg at that stage, with thin but durable rind and bright red sweet flesh. |
| **Mel 38** | **Sweet Beauty** |
|  | Oblong-shaped fruit with deep green rind and broad dark stripes. About 3-4 Kg in weight, with deep red, sweet flesh, around 12-14% on Brix. It is usually ready to harvest about 80-85 days after sowing. Ships and stores well. |
| **Mel 39** | **Feeling** |
|  | Plant is vigorous and sets fruit well. The fruit is oblong, about 3-5 Kg in weight, with green rind and black-green stripes. The bright red flesh is fine, tender, juicy and sweet with a sugar content of about 12% on Brix. The rind is thin but tough which makes it a good shipper. |

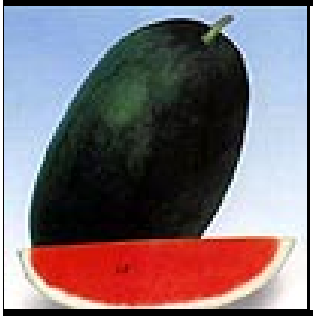
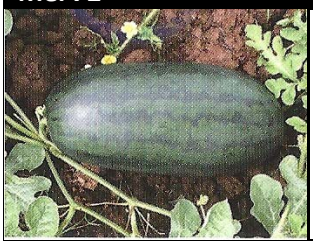
| Mel 40 | Grand Duchess |
|---|---|
|  | This early Sugar Baby type watermelon can be harvested about 80-95 days after sowing. The vigorous vine provides good foliar coverage and excellent yield. Plant produces deep-globe fruit around 6 kg, which has dark green rind with thick stripes and deep red juicy flesh. |
| **Mel 41** | **Sureness** |
|  | A revolutionary type of yellow-fleshed watermelon. Dark skin with vague stripes, tall globe-shaped, around 4-5 kg in weight, with crisp and fine quality flesh. Strong resistance against diseases. It usually takes 80-85 days from sowing to harvest. |
| **Mel 42** | **Diana** |
|  | The attractions of this variety are its beautiful golden-yellow rind and the uniform oblong shape. The vigorous plant is early and productive, with a strong fruit-setting. Flesh is red, tender and juicy, with 12% sugar content. The rind is thin but good for shipping and storage. Approximately 2.5 Kg in weight. |
| **Mel 43** | **New Queen** |
|  | A new variety with bright orange-yellow flesh. Plant is vigorous, early, and prolific. Fruit is uniform, icebox-shaped with light green rind and distinctive dark green stripes, and weighs about 2.5 kg. The stunning orange flesh is exquisite, juicy, with very few seeds and about 12% sugar content. During maturity stage, extra care should be taken for the moisture content of soil and the prevention from spider mites in order to avoid cracking. |
| **Mel 44** | **New Orchid** |
|  | Vigorous and prolific. Fruit is oblong, weighing about 3-4kg. Rind is green with dark green stripes. Flesh is orange-yellow, finely textured, and has an average sugar content of 12%. Good shipper. |

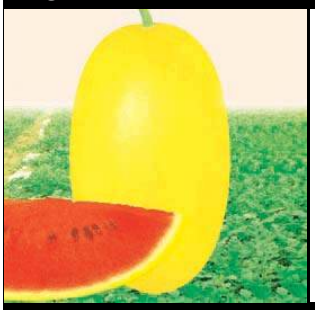
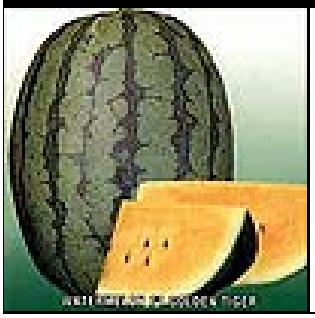
| Mel 45 | Peace |
|---|---|
|  | This excellent new hybrid resembles our Yellow Baby. It is early, and sets fruit easily. Round, weighs 3-4 kg, and has green rind with dark green stripes. Yellow flesh is tender with fine texture, juicy and sweet. A good shipper. |
| **Mel 46** | **Yellow Baby** |
|  | This 1975 All-America Selections Winner is early, productive, sweet-flavoured, and has fewer seeds than other icebox watermelons. Flesh colour is attractive, mouth-watering, pineapple-yellow. Fruit is almost perfectly round, about 15 cm in diameter and 4 kg in weight. The outer rind is light green, handsomely marked with dark green stripes, thin but tough. |
| **Mel 47** | **Petite Yellow** |
|  | A heat-tolerant variety. Resembles our Supreme Baby in characteristics such as vigor and fruit-set. Has excellent quality. Its rind is tougher and more resistant to cracking. |
| **Mel 48** | **Gentility** |
|  | Mini seedless watermelon. Gentility is a portable icebox Crimson Sweet watermelon with broad stripe. This variety is an early maturity hybrid. The globe shaped fruit weighs about 2.9Kg. It is considered a slightly lager choice among the mini types. |
| **Mel 49** | **Queenlet** |
|  | Queenlet is another Sugar Baby type icebox seedless watermelon. It can be harvested around 80-92 days after sowing, when the globular fruit is about 2.2-2.6 kg in weight. The deep red flesh has a delicious flavour with fine quality and very little white rudimentary seeds. This variety has black-green rind that is good for shipping and storage. |

| Mel 50 | Felicity |
|---|---|
|  | Vigorous, medium-early, and strong fruit setting. The fruit is uniform and high globe, showing black-green stripes on light green rind. The fruit weighs 5-7 Kg, with crystal-yellow, tender, juicy flesh. It is of excellent quality and it has a sugar content of 11% on Brix. Few small rudimentary seeds and a good shipper. |
| **Mel 51** | **Orchid Sweet** |
|  | Our yellow-fleshed seedless watermelon is widely adaptive and sets fruits easily. Fruits are medium in size, globe shaped, and weighing 4 kg approximately. Rind is light green with dark green stripes. Flesh is bright yellow, juicy, crispy and sweet. |
| **Mel 52** | **Prosperity** |
|  | Vigorous, with good fruit-set and high yield. A round fruit with dark green rind weighing about 6 Kg. Rind is thin but has good shipping quality. Flesh is uniform bright red and less prone to hollow heart. Very juicy, with 12%-15% sugar content. White rudimentary seeds are few and small. Excellent quality. |
| **Mel 53** | **Farmers Wonderful** |
|  | A triploid seedless variety developed and released by Known-You in 1970. Although it has short vines, it is very productive and sets fruit early. Fruit weighs about 7 kg and is globe-shaped. Rind is green, striped with dark green bold lines. Flesh is bright red, crispy, juicy, very sweet, and with excellent quality. Suitable for home garden and roadside market. |
| **Mel 54** | **Ring 601 (= QY028)** |
|  | Early maturity. Easy Fruit setting, long oblong shape, green rind with dark green dentation stripe on it. Average weight is about 2-3kg, higher yield. Fruit skin thickness about 0.8cm, dark red flesh, crispy and juicy, sweetness (TSS) 13%. Rind has strong hardness, suitable for long time storage and long distance shipping. Tolerance to high temperature. Wide adaptability. |
| **Mel 55** | **Ring 603 (= QY029)** |
|  | Early maturity. Easy fruit setting, oblong shape, green rind with dark green dentation stripe on it. Average weight is about 3.5-4kg. Fruit skin thickness about 0.8cm, deep red flesh, crisp and juicy, sweetness (TSS) 13%. Rind has strong hardness, suitable for long time storage and long distance shipping. Strong resistance to high temperature and moistness. |

| Mel 56 | Y1014 |
|---|---|
| Not available | 3-4 kg; striped; red flesh |
| **Mel 57** | **Y1018** |
|  | Similar to QY031 (Grace Lin). Early maturity, strong resistance to disease, tolerance to low temperature and dim light. Oblong shape, green rind with dark green stripe. Average weight is 2-2.5kg, rind thickness about 0.4cm, difficult to fruit cracking. Deep red flesh, crispy and juicy, sweetness (TSS) 14%. |
| **Mel 58** | **Y1046Y** |
| Not available | 3-4 kg; striped; red flesh |
| **Mel 59** | **PS034** |
|   | Extra early maturity, sets fruit very well. Fruit is round, 2.0-2.5kg with yellow flesh, thin green rind with black stripe. |
| **Mel 60** | **PS035** |
|  | Extra-early maturity, ice box type. Sets fruit very well. Fruit is round, 2.5-3.0kg with red flesh, thin rind green with clear dark stripe. |
| **Mel 61** | **PS036** |
|  | Early maturity, ice box type. Fruit setting easy. Fruit is long oblong shape, dark green rind with black stripe hard and 0.8cm thick, flesh red, taste crisp and good, fruit weight 4kg. |
| **Mel 62** | **PS036B** |
|  | Early maturity, ice box type. Oblong fruit, red flesh, dark green rind with black stripe, fruit weight 3kg. |

| Mel 63 | Golden Sun |
|---|---|
|  | Early maturity with 26 days of fruit development. Round shape and yellow rind covering slender dark yellow stripes. Peach flesh with 12% sugar content. 0.4cm thickness of rind. 2-3 kg average weight; a larger one can reach up to more than 4 kg. |
| **Mel 64** | **Golden Beauty** |
|  | Early maturity with 26 days of fruit development. Yellow rind covering with slender dark yellow stripes. Peach flesh with 13% sugar content. 2.5-3 kg average weight. A larger one can reach up to 4 kg. |
| **Mel 65** | **Typhoon** |
|  | High fruit setting and high yield. Fruits are small oblong with red flesh and very sweet taste. Skin displays dark green background with black-green stripes. Rind is smooth and thin. Very resistant to cracking. That makes it suitable for transportation. Medium maturity: about 70-75 days after sowing, weight: 2.5-3.5 kg (5.5-7.7 lb) per fruit. Resistant to *Fusarium*, Anthracnose and *Phytopthora*. |
| **Mel 66** | **#555** |
|  | Hybrid, early maturing, 80 days for the growth period, vigorous, good fruit-sitting, oval shape, green rind, with dark green stripes on the rind, beautiful in look, around 1.5-2.5 kg/fruit, 0.2-0.5 cm thick for the rind, not easy to break, well for shipping, red flesh, excellent for crispy, juicy tastes, 12-14 degree for sugar content in central flesh. |
| **Mel 67** | **Baby Dragon 2** |
|  | F1 Baby Dragon 2 is a new highly productive striped hybrid watermelon. Plants produce oblong shaped fruits weighing 2.5-3 kg (5.5-6.6 lb) each. The attractive fruits have a light green colour with dark green stripes. The flesh colour is deep red, sweet, very compact and juicy. F1 Baby Dragon 2 displays good resistance/ tolerance to Fusarium wilt race 1-2. |

| Mel 68 | Dark Belle |
|---|---|
|  | Very high fruits setting and high yield. Fruits are small oblong with red flesh and very sweet taste. Skin displays dark green background with black-green stripes. Rind is smooth and thin, though Sugar Belle is very resistant to cracking. That makes it suitable for transportation. Medium maturity: about 70-75 days after sowing, weight: 2.5-3.5 kg (5.5-7.7 lb) per fruit. Resistant to *Fusarium*, Anthracnose and *Phytopthora*. |
| **Mel 69** | **Dark Dragon** |
|  | Very high fruits setting and high yield. Fruits are small oblong with red flesh and very sweet taste. Skin displays dark green background with black-green stripes. Rind is smooth and thin, though Dark Dragon is very resistant to cracking. That makes it suitable for transportation. Medium maturity: about 70-75 days after sowing, weight: 2.5-3.5 kg (5.5-7.7 lb) per fruit. Resistant to *Fusarium*, Anthracnose and *Phytopthora*. |
| **Mel 70** | **Dragon Skin** |
|  | No description available. |
| **Mel 71** | **New Dragon Skin** |
|  | High fruits setting and high yield. Fruits are small oblong with red flesh and very sweet taste. Skin displays dark green background with black-green stripes. Rind is smooth and thin. NEW DRAGON SKIN is very resistant to cracking. That makes it suitable for transportation. Medium maturity: about 70-75 days after sowing, weight: 2.5-3.5 kg (5.5-7.7 lb) per fruit. Resistant to *Fusarium*, Anthracnose and *Phytopthora*. |
| **Mel 72** | **New Belle** |
|  | Similar to Sugar Belle. Very high fruits setting and high yield. Fruits are small oblong with red flesh and very sweet taste. Skin displays dark green background with black-green stripes. Rind is smooth and thin, thoughvery resistant to cracking. That makes it suitable for transportation. Medium maturity: about 70-75 days after sowing, weight: 2.5-3.5 kg (5.5-7.7 lb) per fruit. Resistant to *Fusarium*, Anthracnose and *Phytopthora*. |

| Mel 73 | Sugar Belle |
|---|---|
|  | Hybrid variety with very high fruits setting and high yields. Fruits are small oblong with red flesh and very sweet taste. Skin displays dark green background with black-green stripes. Rind is smooth and thin, though Sugar Belle is very resistant to cracking. That makes it suitable for transportation,. Medium maturity : about 70 - 75 days after sowing, weight: 2.5-3.5 kg (5.5-7.7 lb) per fruit. Resistant to *Fusarium*, Anthracnose and *Phytopthora*. |
| **Mel 74** | **Pure Gold** |
|  | Maturity (days from sowing): 75 days. Fruit weight: 2.5 kg (5.5 lb). Fruit shape: oblong with red flesh, golden yellow rind. Extra early variety. Resistant to *Fusarium*. |
| **Mel 75** | **Golden Tiger** |
|  | Maturity (days from sowing): 90 days. Fruit weight: 4-5 kg (10 lb). Fruit is oblong, with yellow flesh, light green rind with dark green stripes. Highly productive, sweet and very compact. Resistant to *Fusarium* 1. |