Horticulture Innovation Australia

Final Report

Evaluation of apricot breeding lines for processing

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Summary

The apricot processing industry in Australia is dependent on a single variety, namely Trevatt. This reliance exposes the industry to a high risk of crop failure from seasonal conditions and the biennial bearing nature of this variety. Progress has been made towards addressing this issue in previous projects titled HAL CF09003 "Apricot Breeding lines for processing" and its predecessor HAL FR05001 "Evaluation of apricot breeding lines for canning". In this project the outstanding lines "Bounty" and "Line 32255", previously identified continued to be evaluated in commercial size test planting as a final proofing stage prior to promotion to industry.

A further 11 new promising apricot lines for canning were identified. Of these 29110, 34769 35209 and 36480 appear to have the greatest potential on data gathered to date. Canned fruit quality of these selections has ranked highly in each year of evaluation, with evaluation trees planted at Loxton carrying heavy crops of clean good quality fruit each year.

The scaling up of "Bounty" production in the Shepparton area has encountered major complications with the occurrence of graft incompatibility, tree losses and soft fruit not previously seen in smaller trials. The reasons for this are unclear and SPC Ardmona (SPCA) has decided not to proceed with further planting of this variety but will retain current plantings and try to find solutions to these issues.

A small number of trial trees of line 32255 and line 15742 have been planted for further evaluation by SPC Ardmona (SPCA) in the Shepparton area. All other identified lines have been grafted at Loxton Research Centre and will be supplied to SPCA as bare rooted trees for evaluation in winter 2017.

This work completes the screening of the SARDI Apricot Breeding Program for lines of canning potential. It is expected that at least two of the promising selections identified in this and earlier projects will be proven for commercialization. The addition of these new varieties as growing options will reduce risk, increase supply and supply reliability for the Australian processing industry.

Keywords

Apricot; canning fruit; SPC Ardmona; productivity; apricot breeding; apricot processing

Introduction

The apricot processing industry in Australia is dependent on a single variety, namely Trevatt. Reliance on one variety restricts the time that apricots can be processed, limiting the total tonnage possible. Relying on one variety also exposes growers and the processor to a high level of risk from seasonal events. Additionally, substantial annual variation in the tonnage currently occurs due to the biennial bearing nature of Trevatt.

Australian apricot processing is unique in world terms as the fruit is processed and canned with its skin on, requiring a robust, clean and blemish resistant apricot variety of good color and flavor when canned to meet consumer expectations.

In an attempt to overcome its reliance on Trevatt, the industry has evaluated other commercially available apricot varieties. The American variety "Patterson" was the only variety to show potential for processing, testing was progressed to a commercial scale. Unfortunately problems were encountered with flavor in the canned product being dependent on fruit having reached an acceptable maturity. However, once processed the texture of the fruit became mushy and fragmented at this more advanced maturity, resulting in a poor quality final product.

In response HAL project (FR05010) was conducted to evaluate apricot selections for their processing potential from the SARDI apricot breeding program based at Loxton in the Riverland of South Australia, which originally focused on producing varieties for drying (HAL project DT04001). Through this project one outstanding selection for processing was identified, "Line 3444", subsequently named "Bounty". "Bounty" has been licensed to SPC Ardmona who have proceeded with a controlled commercial release to a group of contracted apricot growers. A subsequent HAL project (CF09003) identified a second outstanding line "Line 32255" and several others worthy of further investigation for their canning potential.

This project continued and completed the search for other lines suitable for processing from within the SARDI apricot breeding program and progressed the evaluation and commercialization of selections that had already been identified. Without this project the commercial potential of these selections to the Australian processing industry would not have been identified and potentially lost.

Methodology

This project used the remaining selections from over 30 years of apricot breeding and evaluation within the SARDI Apricot breeding program aimed at producing drying and later fresh market apricots. At the commencement of Project FR05010, a forerunner to this project, managerial and technical staff of SPC Ardmona (SPCA) and SARDI researchers met and agreed on criteria and assessment protocols for canning and a screening process for processing apricots was developed. SARDI project staff also met with a number of SPC Ardmona's key apricot suppliers to gain an orchard production and harvesting perspective. Requirements for an apricot canning variety developed are listed in Table 1.

It was also recognized that breakdown of texture and the development of undesirable flavours during canning would be significant causes of rejection for many of the selections likely to be evaluated. Unfortunately, a method to screen out selections for these traits based on easily measurable fresh fruit characteristics was not available from either SPCA or the literature. Experience gained in FR05010 and CF09003 showed that simply meeting the physical and aesthetic fresh fruit specifications are no guarantee of success in the canned product and that the attrition rate in identifying good quality canned lines should be expected to be very high. However, the results from FR05010 and CF09003 in identifying "Bounty" (selection 3444) and selection 32255 also show that successes are likely.

Lines to be evaluated for canning are selected by two methods. 1. Database search, as part of the laboratory fruit assessment carried out on all cropping lines each season within the Loxton apricot breeding program. Lines considered to have attributes suitable for the processing sector can be flagged on a specific assessment allowing them to be actively searched for in the program's database later. 2. General search and review of parameters such as, time of maturity, size, firmness and cropping level history coupled with a review of assessment comments to exclude lines that are heavily blushed or blemish and weather damage prone. In each year of this project, information contained in the apricot breeding program database was reviewed in this manner to compile a list of lines of interest to submit for processing and evaluation as a canned product.

Each season the list of selections for evaluation by canning was prepared prior to commencement of apricot harvesting. This allowed determination of current season crop loads and likely fruit availability, light cropping lines could be noted and removed from the list if extenuating circumstances could not be found for that poor cropping habit. Pre-selection also enables lines to be specifically monitored and target harvested at an appropriate maturity for canning from amongst the fresh market, general agronomic and drying assessments that were occurring at specific and different maturities around them.

Lines were identified from the SARDI Apricot Breeding Program to broadly fit the range of criteria described in Table 1. Samples of 2-5 kg were harvested from trees of the selections to be processed at the appropriate maturity. After harvest fruit was cooled to 2°C and samples accumulated in the cool store before being packed in bags, sealed styrofoam boxes packed with gel-ice coolant and transported to SPCA in batches by truck.

Table 1: Requirements for an apricot canning variety

Attribute	Criteria
Fruit	
Size	Minimum 1 ½ inches , preferred 1 ¾ inches (measured tip first through sizing ring)
Shape	Needs to align on suture for cutting machines, compressed cheeks. Not round or irregular.
Colour	Apricot, Not red or pale. Even colouration through fruit important
Blush	Nil preferred (but this may be negotiable)
Firmness	Firm at canning maturity, capability for mechanical harvesting
Stone	Need to be completely free Prefer small stones
Total Soluble Solids	No minimum
Flavour	Apricot flavour is important (Comparator: flavour of 'Patterson' is borderline)
Blemish	No blemish is a critical Not prone to rain cracking No freckle or scab
pH	pH ≤ 4.3
Tree	
Timing of harvest maturity	Trevatt or earlier preferred Variety would be considered for up to 12 days after Trevatt
Nature of harvest maturity	Uniform throughout tree, capability for mechanical harvesting Fruit holds on tree (does not drop)
Timing of Flowering	Trevatt or later preferred
Yield	Consistent, non-biennial bearer Essential for it to be as good or better than Trevatt

Each season of the project great effort was put into sourcing fruit samples at the appropriate maturity stage. Hot weather and other circumstances often impact on this task. A guide was developed to rate fruit maturity for canning prior to it leaving cold storage at Loxton using C= canning maturity + or – to signify fruit that was more or less mature than desirable according to the breeders experience. Fruit was generally picked at the desired stage of maturity. However, this did not ensure that all fruit samples at the time of processing were of good quality. Storage associated with accumulating samples for transport, transportation and delays in processing in some instances resulted in deterioration in the quality of some selections prior to canning. This was recorded and is documented in the results. These impacts have been taken into account when interpreting canning results and making recommendations and ratings regarding the potential of individual selections.

In all seasons pre-processing observations were made regarding harvest date, crop load, maturity rating, size, texture / firmness, ground colour, blemish and blush on the fresh fruit of each selection using consistent experienced personnel. Comments were also noted on characteristics such as blemish, bruising, ripeness, freeness of stone and presence of pit burn or rots.

Samples were canned in light syrup (20 °Brix) using a standard apricot cook in a rotary cooker (11 minutes at 100°C). The number of 75mm diameter or 470gm (420gm net) cans processed varied according to quantity of sound fruit available. Normally 7 to 10 cans were processed.

After maturing for four months in can each season the canned samples were opened and the post-canning quality of the fruit halves assessed at SPC Ardmona by a consistent group of experienced assessors. Fruit was scored for each of the attributes of overall appearance, colour, texture and flavour using rating scales. Specific notes were recorded on characteristics such as stone fragments, dark spots, mixed quality, uneven colour or texture, air bubbles or separation of the skin.

Outputs

Potential new quality canning apricot varieties identified.

Information about tree, fruit and canning performance across growing seasons collected for the identified varieties.

Trial trees produced for further industry evaluation of potential new quality canning apricot varieties.

Trial trees planted by SPCA for ongoing evaluation.

Outcomes

The identification and selection of 13 potential new apricot canning lines for production in Australia

The provision of trial trees to further evaluate these 13 new lines to SPCA. This allows further evaluation in the region in which they are to be grown and continues the evaluation and ultimately the commercialization pathway.

It is expected that varieties from this program could expand the tonnage of apricots by 50%, in addition to some replacement of the existing varieties grown within 5 years of the completion of the project. Evaluation of this project can be assessed by the acceptance of selections as viable processing varieties for future planting and ultimately by the level of commercial planting of these varieties. Through the completion of this project the realization of these ideals is a step closer.

Evaluation and Discussion

Bounty evaluation and commercialization update

Bounty is currently licensed to SPCA who have proceeded to larger scale commercial plantings with the variety. Between 2011 and 2014, 15220 trees were planted on nine grower properties, however graft union incompatibilities have been experienced and these trees have shown high levels of breakout at the graft union. None of the smaller scale test plantings in South Australia or Victoria have previously indicated a problem in this area and the reason for it is unclear. To date the breakout rate stands at approximately 25% but early individual plantings have been as high as 75% and given the vast majority of trees were planted in 2014 this overall rate can be expected to worsen.

Breakouts have appeared with both peach (Nemagauard) and plum (Myrobalan) rootstocks and in all batches of trees produced across several years. The plant health status of the rootstocks and budwood should be investigated to determine whether a causal pathogen such as a virus, viroid, phytoplasma or bacteria can be found given this phenomenon has not been observed previously.

In the Shepparton area in 2013/14 and 2014/15 Bounty fruit also experienced some softness issues on canning. In the 2015/16 season it was decided to pick the variety less mature this proved to be successful as it produced a much firmer product and will become an ongoing management strategy with the variety.

Given the problems experienced with Bounty on scaling up its production SPCA will not be planting further trees. However, it will persist with the trees already in the ground to try and find solutions to the graft incompatibility and softening issues.

2014/2015 Season

During the 2014/15 season 47 apricot samples from the SARDI Apricot Breeding Program were harvested during the period 17/11/14 to 21/12/14 from the list of selected trial canning candidates. Of these 36 were sent to SPC Ardmona (SPCA) at Shepparton for investigation of their canning potential. 11 lines were rejected prior to transport to SPCA on the basis of excessive marking or blush pigmentation of the skin. The 36 lines sent represented 35 different genotypes with two samples being of line 34769 at different maturities. All lines were subjected to a pre-cooking analysis of size, flesh texture, colour and overall quality rating. Lines were then canned in light syrup (20 °Brix) using a standard apricot cook in a rotatory cooker (11 minutes at 100°C). After canning the lines were further assessed for overall fruit, integrity (firmness and appearance), flavour, juice quality and colour.

The pre-transport and post canning assessment results can be seen in Appendix Tables 2 & 3 respectively. A more detailed discussion of the season's results is also available in the Appendix accompanying these tables. The 20 lines which did not score well were not further tested for canning potential and marked as unsuitable for canning.

Based on previous good performance, trees of 3444, 15742, 16222 and 32255 were provided to SPC/Ardmona for local trials in the Shepparton District.

2015/2016 Season

In total during the 2015/16 season 42 apricot samples were harvested for canning evaluation at SPCA. An initial batch of 34 apricot samples was sent to SPC Ardmona (14/12/15) for trial canning, pre-transport and post canning assessment results can be seen in Appendix Tables 4 & 5 respectively. A more detailed discussion of the season's results is also available in the Appendix accompanying these tables. Two lines 34769 and 35213 were represented by two samples from different source trees, both 34769 samples passing and both 35213 samples being rejected.

A second batch of 7 samples were sent to SPCA (12/1/16) however these subsequently became frozen in storage at SPCA and were unsuitable to be processed.

Another sample, line 30607 harvested 27/11/15 was not sent for trial canning due to significant marking and bronzing making it unsuitable for processing.

SPCA deemed the best performing lines this season to be line 29110 (15 points), followed by, 34769, 35209, 36341, 37612 (14 points) and 24086 and 37356 (13 points)

Overall, 10 lines produced acceptable products worthy of further consideration. These were with post canning assessment points recorded in brackets, 15742(12), 25086(13), 29110(15), 34769a(14), 34769b(12), 35209(14), 36341(14), 37356(13), 37612(14) and 37552(11). These lines have been grafted to provide trial trees to SPCA for further evaluation, with the exception of line 36341 which appears to produce more delicate and bruise prone fruit and has suspected lower cropping levels. Due to this it has been removed from the program on agronomic grounds.

Summarizing Overall Canning Prospects

In summarizing the processing results the canning evaluations need to be compared with fresh fruit quality parameters which were recorded prior to transport and canning, and with other agronomic production traits to produce an overall impression of the lines longer term overall canning potential.

Line 29110 scored 18/20 and 15/20 with fruit of good canning maturity in 2015 and 2016 respectively. An unblushed very firm pastel apricot that can sometimes look a little pale when immature, this line does develop good colour and very good flavour. This line has a nice free stone, clean appearance, crops well on plum rootstock and appears self-fertile. Long term prospects appear, very good.

Line 34769 was tested at advanced and very advanced canning maturity in 2015 and 2016, scoring 19/20 & 20/20 and 14/20 & 12/20 respectively. This line is large, clean and very firm, displaying very good cropping and self-fertility. Less mature it can appear to have greener shoulders and only seems to show softness in a can at quite advanced maturities. The flesh of this line has significant structure and a fine almost slippery texture with very good flavour. Long term prospects appear, very good.

Line 32255 was unable to be canned in this project from the Loxton Research Centre following outstanding results in 2012 and 2013. This was due to the seedling parent tree being removed to reuse the block of land for other purposes and trees on rootstock still to come into cropping. This line presents as possibly self-fertile and amongst other trees was producing good crops which dropped off with their removal. The reasons for this are nuclear and may rage from increased predation of flower buds to

reduced bee activity due to isolation. Fruit is well coloured, clean and firm with easily removed stones. Trees on rootstock appear well set up to crop in 2017. Overall the prospects of this line are rated as good.

Line 35209 was not processed in 2015, however in 2016 on fresh fruit judged to be a mixture of correct and slightly advanced maturity for canning, scored 14/20 and comparable to the previously well performed Line 34769.This line produced consistent high crops of large, clean, firm attractive fruit with a flattened egg shape making them ideal for machine aligning to remove the stone. This line appears self-fertile and despite a lack of supporting canning data from other seasons looks to have good long term prospects as a canning variety at this stage.

Line 36480 scored 14/20 using fruit much more mature than desirable in 2015 and duly scored poorly for texture being noted as soft with flakey skin and stringy texture in the canned product. In 2016 on good maturity fruit albeit from a heavily over-cropped tree and greatly reduced fruit size it scored 10/20. Notably the main concern was its small size, however, the good rating for texture in the canned product is encouraging. Given this line is very early maturing and was likely stored longer before processing than any other line its results may be much better than they first appear. This line is self-fertile, precocious on plum rootstocks, well colored and shows an extremely high cropping ability with excellent return crop capabilities which have yet to fail. Overall this line could prove to have good longer term prospects in canning.

Line 36894 scored 19/20 on slightly more mature fruit than ideal, fresh fruit was firm and clean from a moderately heavy cropped tree. Canned quality was marked down very slightly on a softer texture but was overall excellent. This line was not canned in 2016 as a delay in canning results from 2015 meant breeding programs culling was done on the basis of fresh and dried observations and trees of this line were cut down but have been subsequently recovered. This line is possibly self-fertile, small to medium very attractive clean and crunchy, firm fruit with excellent texture and balanced acidity. To date it has shown a moderate cropping habit. Overall this line appears to have moderate to good prospects.

Line 37356 scored 14/20 using fruit much more mature than desirable in 2015 and duly scored poorly for texture being noted as soft with peeling skin in the canned product. In 2016 on slightly more mature fruit than ideal and from a heavily cropped tree with reduced fruit size it scored 13/20. Texture in this sample was noted as very good, although worryingly it was marked down on colour in both seasons. A very early season, self-fertile, heavy cropping, very firm clean apricot line with moderate to good prospects if canned colour issues are resolvable.

Lines 15742(16430) and 16222 are very similar in their fresh fruit and agronomic attributes. Large, firm and clean with good internal colour but often with a light greening of the suture and slight suture cracking due to increased size when on lighter crops. Over sizing may be an issue with this line. Both lines crop very well on plum stock. In 2015 and 2016 15742 samples appeared to be of a more advanced maturity compared to 16222 yet were rated higher, 15/20 &12/20 compared to 13/20 & 8/20. 16222 appears self-fertile whereas 15742 is yet to be determined. Given the close ratings of the fresh fruit and the improved process ratings of 15742 it is suggested that 16222 be discarded in favour of 15742. Who's long term prospects appear, moderate, given its performance is usually better than average but rarely outstanding.

Line 23547 scored 15/20 in 2015 but was not processed in 2016 as it was amongst the unfortunate

second group of samples that became frozen in storage at SPCA. The 2015 sample was assessed as more mature than desirable so the moderate canned product downgrades on texture and flavour are understandable. A likely self-fertile line this moderate cropper to date matures toward the end of our preferred harvest window making it an option should a range of varieties be preferred to spread risk. A very firm, higher total soluble solids line with balanced acidity this line can mark, shrivel and rain damage at advanced maturities but it remains to be seen if this will be an issue at canning maturity. The overall rating of its long term prospects on available information are probably moderate at this point.

Line 24086 scored 18/20 and 13/20 with fruit of good canning maturity in 2015 and 2016 respectively. This is a deep colored extremely firm line that can where exposed develop significant blush and is clearly able to produce a very good canned product. The line produces moderately heavy crops on plum rootstocks despite not appearing self-fertile and so presents as easily pollinated by pollinators and well suited to the Australian climate. A large fresh market planting of this line in the Riverland SA, is producing well. Further evaluation in larger plantings is warranted for canning. The overall rating of its long term prospects on available information are probably moderate at this point.

Line 37612 was scored 13/20 and 14/20 in 2015 and 2016 respectively using fruit at the correct maturity for canning from heavily cropped trees. In 2015 the canned product was noted as a being paler with flat flavour while in 2016 from a very heavily cropped tree the product was noted as small. Cropping patterns from this line appear good while the fruit itself is firm it may bruise at more advanced maturities and may be genetically limited to the medium to small size range. The line presents as self-fertile. Overall its appears worthy of further investigation but may only be a moderate prospect in the longer term.

Line 36539 was scored at 20/20 and 9/10 in 2015 and 2016 using fruit at an advanced maturity and correct maturity for canning respectively from heavily cropped trees. In 2016 the canned product was marked down on firmness and flavour which is confusing given the 2015 sample was likely more mature when processed. One possible explanation may be hot weather at harvest leading to poor storage awaiting processing. This line is a good cropping, clean, firm apricot with an easily removed stone and a texture described as a crunchy shell around a melting center. It appears as possible self-infertile. Clearly worthy of more investigation on the 2015 result, overall it is rated as a moderate prospect.

Line 37752 has been included despite scoring only 11/20 points in 2016, it is a very productive, self-fertile, clean line, noted as having variable maturity from an over-cropped source rather than more terminal characters like tart or off flavours. Hence it may be wise to give it some further consideration before removing it from contention as a processing line. Its chances of making canning grade can only be considered as moderate at this stage.

Ironically "Bounty" (3444) performed poorly in the two seasons of this project from a new set of evaluation trees. The Bounty tree is extremely vigorous and the new evaluation trees were due to begin economic cropping in 2014 a year in which the region had severely reduced apricot crops. The well-established trees without an economic crop to reduce their vigor overgrew and it has been a challenge to rebalance them into a cropping regime. Fruit from these trees tended to be very large and softer leading to scores of 10/20 and 9/20 in 2015 and 2016 respectively. Both seasons' canned fruit was marked down on flavour and texture. In 2016 the fresh fruit appeared to have been picked in a heat wave showing significant marking which while showing up as additional softening was not overly evident in the canned product.

Line 35094 was scored at 17/20 and 9/10 in 2015 and 2016 using fruit at an advanced maturity and correct maturity for canning respectively from heavily cropped trees. In 2016 the canned product was marked down on firmness, flavour and appearance which is particularly confusing given the 2015 sample was likely more mature when processed. This line crops very well but is very large and can oversize and develop a lot of blush on exposed fruit with a light speckling of the skin that can give fresh fruit a "dirty" appearance. Being possibly self-infertile and having a lack of other uses it has been removed from the breeding program.

Line 37448 was scored at 18/20 and 8/20 in 2015 and 2016 using fruit at canning and slightly advanced canning maturity respectively. In 2015 fruit was smaller on a moderately heavy crop and displayed some flaking of the skin. In 2015 fresh fruit was noted to show blemish and shrivel on a light moderate crop and performed below average on all canning criteria. This line is possibly not self-fertile and appears to have some fresh fruit quality issues with inconsistent cropping and has been removed from the program.

Line 37440 although scoring 16/20 in 2015 was not progressed in 2016 and has been removed from the program. Although scoring highly all its faults all came in the texture area with processed fruit being soft with peeling skins. When evaluated for the fresh market it was also noted fruit softened in storage and rapidly on ripening with some suture cracking. It is also possibly self-infertile.

Average agronomic information for the identified canning apricot lines of interest from trees grown at the Loxton Research Centre is presented in Table 6 in the Appendix.

A review of the parents of lines identified as promising reveals the difficulty in predicting apricot lines that might make suitable canning apricots with very little recurrence of individual parents. Indicating the genetics behind the quality traits is likely to be complex. However if this group could be studied for quality molecular markers it may reveal a useful molecular breeding tool for narrowing and improving the speed of any future searches.

This project all but completes the screening of the SARDI Apricot breeding program for lines of promising processing ability. Further scrutiny of the lines remaining that appear suitable and have not been screened by canning leaves only 37105. If this could be run through the testing regime as described above it would fully complete this work. Further evaluation of these lines in the Shepparton area and their canning quality over several years still needs to be done before further commercialization.

Recommendations

1. It is recommended that lines 15742, 23547, 24086, 29110, 32255, 34769, 35209, 36480, 36539, 36894, 37356, 37612 and 37552 are grafted and grown in the Shepparton area and that fruit from these lines is canned and assessed over several seasons before further commercialization is attempted.
2. If there were a desire to fast track certain lines the author believes that on available evidence lines 29110 and 34769 are the most worthy followed by 32255, 35209 and 36480.
3. If possible it is recommended that Line 37105 be screened as described to complete the evaluation of the SARDI apricot breeding program for lines of processing potential

Scientific Refereed Publications

None to report

Intellectual Property/Commercialisation

No commercial IP generated

Intellectual property relating to the breeding lines developed by the SARDI apricot breeding program will remain the property of the existing stakeholders as documented under HAL projects DT09003 and its predecessors. HIA, as an equity participant, will be consulted prior to the signing of any agreements with third parties regarding intellectual property developed in HAL DT09003 or associated background breeding projects. This project was an evaluation only project.

Appendices

2014/2015 Season

Apricot fruit set at the Loxton Research Centre for the 2014/15 season was good and generally regarded as average overall. The poor previous season with very light crops contributed to a favourable "on-cropping" season. Winter chilling was 1073 Richardson-Utah Chill units, 5% above the 18 year average for Loxton Research Centre, accumulation began late and slowed towards the end but made good progress through the middle range and mild conditions largely without the major warming periods of the previous year, rendering what occurred much more effective.

Significant periods of the pollination period were favourable with visible bee activity for critical periods. The growing season was mainly dry and relatively mild, leading to the production of good clean, quality fruit free from weather damage.

During the 2014/15 season 47 apricot samples from the SARDI Apricot Breeding Program were harvested during the period 17/11/14 to 21/12/14 from the list of selected trial canning candidates. Of these 36 were sent to SPC Ardmona (SPCA) at Shepparton for investigation of their canning potential. 11 lines were rejected prior to transport to SPCA on the basis of excessive marking or blush pigmentation of the skin. The 36 lines sent represented 35 different genotypes with two samples being of line 34769 at different maturities. All lines were subjected to a pre-cooking analysis of size, flesh texture, colour and overall quality rating. Lines were then canned in light syrup (20 °Brix) using a standard apricot cook in a rotatory cooker (11 minutes at 100°C). After canning the lines were further assessed for overall fruit, integrity (firmness and appearance), flavour, juice quality and colour.

The 2014/15 season saw the identification of seven very promising new selections with excellent canned quality evaluated for the first time.

Line 36539 (3/12/14) post canning showed firm fruit integrity, good flavour, clear juice and good fruit colour, scoring very highly.

Line 34769 (28/11/14 & 3/12/14) post canning showed firm fruit integrity, good flavour, clear juice and good fruit colour, scoring very highly. The less mature sample downgraded marginally due to paler shoulders in the less mature sample.

Line 36894 (3/12/14) post canning showed medium firm fruit integrity, good flavour, clear juice and good fruit colour, scoring very highly.

Line 37448 (3/12/14) post canning showed firm fruit integrity with some skin flaking, good flavour, clear juice and good fruit colour, scoring highly

Line 29110 (3/12/14) post canning showed firm fruit integrity, good flavour, clear juice and paler fruit colour, scoring highly

Line 35094 (24/11/14) post canning showed firm fruit integrity, reasonable flavour, clear juice and good fruit colour with very large fruit, scoring highly. This is impressive given the extended storage time of this sample which may have adversely impacted flavour and firmness.

Line 24086 (5/12/14) post canning showed variably firm fruit integrity, good flavour, clear juice and good fruit colour, also scoring highly.

A further six lines being evaluated for the first time were identified as being worthy of further investigation. These included line 37440 (1/12/14) which showed good flavour, juice and colour but had softer fruit integrity and some skin peeling. Line 23547 (15/12/14) showed good juice and colour with a firm but stringy integrity and a flat flavour profile. This sample was on investigation picked soon after a rain event which may have contributed to a lower flavour score. Line 36480 (17/11/14) showed good juice and colour with a firm but stringy and slightly skin flaking habit, flavour was reasonable. This was regarded as a positive result given this line was in storage far longer than any other. Line 37356 (24/11/14) showed good flavour and juice with a paler colour however the integrity was softer with some skin peeling. This was regarded as a positive result given the extended time in storage and the pre-canning assessment scored the sample as being harvested more mature than we would normally like. Line 37612 (10/12/14) had medium firmness and good quality juice with a pale colour and a flatter flavour profile. An encouraging result considering the heavy crop on the harvested tree and post rain event harvest timing.

Other previously evaluated lines included were 15742 (10/12/14) which had large firm fruit, good clear quality juice but a flat flavour profile and paler colour. This line scored reasonably overall without being outstanding as did Line 16222 (15/12/14) for similar reasons. Line 3444 "Bounty" (3/12/14) assessed poorly this season on a light crop which saw fruit reach excessive sizes resulting in poor firmness and peeling skin with a low flavour profile, juice quality and colour were good however.

Line 32255 was not evaluated due to the unavailability of fruit as evaluation trees have not yet begun cropping.

The pre-transport and post canning assessment results can be seen in Appendix Tables 2 & 3 respectively. A more detailed discussion of the season's results is also available in the Appendix accompanying these tables. The 20 lines which did not score well were not further tested for canning potential and marked as unsuitable for canning.

Based on previous good performance, trees of 3444, 15742, 16222 and 32255 were provided to SPC/Ardmona for local trials in the Shepparton District.

Table 2 Harvest date, maturity rating, crop load on tree and characteristics of fresh fruit of apricot breeding line selections assessed for canning in the 2014/15 season.

Selection	Harvest date	Maturity Rating	Crop load	Characteristics of fresh fruit				
				Size	Texture	Ground Colour	Blush	Quality and specific defects
3444	3/12/14	C+	Light Moderate	Very Large	Medium	Green/Light Orange	Nil	Ok- moderate marking, very large
15742	10/12/14	C++	Moderately Heavy	Large	Firm	Orange	Moderate	Ok- clean and slightly uneven with some green striping of suture
16222	15/12/14	C+	Heavy	Large/Very large	Firm	Orange	Very Slight	Good- clean, large, firm
23547	15/12/14	C++	Heavy	Medium	Very Firm	Light Orange	Very Slight	Good- clean and firm
24086	5/12/14	C	Moderately Heavy	Small/Medium	Very Firm	Deep Orange	Moderate	Good- clean and very firm
29110	3/12/14	C	Moderate	Medium	Very Firm	Light Orange	Slight	Excellent- clean & firm
29335	1/12/14	C++	Moderate	Medium/Large	Medium	Light Orange	Moderate	Suspect- marks & quite blushed
30754	9/12/14	C+	Heavy	Large	Medium	Light Orange	Very Slight	Good- clean and large
30854	1/12/14	C++	Light	Large	Firm	Orange	Nil	Good- large only slight marking
31054	15/12/14	C	Very Heavy	Medium/Large	Medium	Light Orange	Moderate	Suspect- moderate marking & blush
31072	15/12/14	C+	Very Heavy	Medium	Firm	Orange	Very Slight	Suspect- skin marks a lot
32231	1/12/14	C	Moderate	Large	Firm	Orange	Very Slight	Suspect- marks a lot, uneven ripening with green band on suture
34769(a)	3/12/14	C++	Heavy	Large	Firm	Light Orange	Nil	Ok- some marking, firm and tough skin
34769(b)	28/11/14	C+	Heavy	Medium/Large	Firm	Light Orange	Moderate	Ok- some marking and blush

Table 2 Continued. Harvest date, maturity rating, crop load on tree and characteristics of fresh fruit of apricot breeding line selections assessed for canning in the 2014/15 season.								
Selection	Harvest date	Maturity Rating	Crop load	Characteristics of fresh fruit				
				Size	Texture	Ground Colour	Blush	Quality and specific defects
35094	24/11/14	C++	Moderately Heavy	Large	Very Firm	Orange	Nil	Ok- some marking, skin speckling makes it look a bit dirty
35490	12/12/14	C++	Moderately Heavy	Large	Very Firm	Light Orange	Moderate	Ok- clean but slightly uneven ripening
36443	20/11/14	C++	Very Heavy	Small	Very Firm	Light Orange	Slight	Ok- very little marking
36449	20/11/14	C++	Heavy	Small/Medium	Firm	Light Orange	Slight	Good- very little marking, even colour
36480	17/11/14	C+++	Very Heavy	Small/Medium	Firm	Orange	Moderate	Ok- marks and softens, even colour
36539	3/12/14	C++	Moderately Heavy	Medium	Firm	Orange	Slight	Good- slight marking but durable
36615	15/12/14	C+	Heavy	Small	Very Firm	Light Orange	Very Sight	Ok- clean, firm and small
36728	10/12/14	C	Heavy	Small	Very Firm	Yellow/Light Orange	Moderate	Ok- clean but small & uneven ripening
36894	3/12/14	C+	Moderately Heavy	Medium	Medium	Orange	Very Slight	Ok- no marking and even ripening
36937	3/12/14	C	Heavy	Medium	Medium	Light Orange	Slight	Ok- no marking but a little pale
37205	5/12/14	C+	Moderately Heavy	Small	Very Firm	Orange	Slight	Ok- no marking & hard but small
37300	5/12/14	C+	Moderately Heavy	Medium/Large	Firm	Light Orange	Moderate	Ok- no marking, variable maturity & some tip cracking
37331	1/12/14	C++	Moderately Heavy	Medium	Medium	Light Orange	Moderate	Ok- no marking
37349	20/11/14	C+	Heavy	Medium	Firm	Orange	Very Slight	Ok- nice look, very slight marking

Table 2 Continued. Harvest date, maturity rating, crop load on tree and characteristics of fresh fruit of apricot breeding line selections assessed for canning in the 2014/15 season.

Selection	Harvest date	Maturity Rating	Crop load	Characteristics of fresh fruit				
				Size	Texture	Ground Colour	Blush	Quality and specific defects
37356	24/11/14	C+++	Moderately Heavy	Medium	Very Firm	Orange	Slight	Ok- no marking, good even colour
37388	1/12/14	C+	Heavy	Small	Very Firm	Deep Orange	Moderate	Good- small, firm, slight marking
37440	1/12/14	C+	Heavy	Medium/Large	Firm	Light Orange	Slight	Good- very little marking
37448	3/12/14	C	Moderately Heavy	Small	Very Firm	Light Orange	Slight	Ok- no marking, bit uneven ripening, green stripe on suture
37473	1/12/14	C+	Moderate	Medium	Medium	Light Orange	Slight	Suspect- moderate marking, uneven ripening with green stripe on suture
37612	10/12/14	C	Heavy	Small	Firm	Light Orange	Very Slight	Ok- clean but slightly uneven ripening, green stripe on suture
37890	24/11/14	C++	Heavy	Medium	Very Firm	Light Orange	Slight	Ok- slight marking, even colour
37986	24/11/14	C++	Moderately Heavy	Medium	Very Firm	Orange	Slight	Good- no marking, even colour

Table 3 Assessment scores for the quality of canned fruit of apricot breeding line selections assessed in the 2014/15 season. Scores are average of 4 experienced assessors with individual attributes judged out of 5 (where 1-poor/soft, 3-good, 5-excellent/firm) and total is sum of the attribute scores (out of 20).

Selection	Assessment scores for characteristics of canned fruit					Comments
	Juice	Colour	Flavour	Texture	Total	
3444	3	5	1	1	10	**Reject:** soft, skin peeling
15742	5	3	2	5	15	**Acceptable**
16222	5	5	2	1	13	**Acceptable**
23547	5	5	2	3	15	**Acceptable**
24086	5	5	5	3	18	**Acceptable:** mixed texture
29110	5	3	5	5	18	**Acceptable:** firm
29335	5	5	1	2	13	**Reject**
30754	2	3	1	1	7	**Reject:** tart, flaking soft fruit
30854	5	5	1	1	12	**Reject:** soft, skin peeling
31054	2	3	2	1	8	**Reject:** soft, inconsistent colour
31072	2	3	1	1	7	**Reject:** soft and tart
32231	3	1	1	2	7	**Reject:** soft and tart with dark colour
34769(a)	5	5	5	5	20	**Acceptable:** firm with apricot flavour
34769(b)	5	4	5	5	19	**Acceptable:** firm with pale shoulders
35094	5	5	3	4	17	**Acceptable**
35490	2	5	1	1	9	**Reject:** mushy & tart
36443	2	3	3	1	9	**Reject:** soft stringy flesh
36449	5	3	4	3	15	**Acceptable:** medium stringy flesh
36480	5	5	3	1	14	**Acceptable:** skin flaking, stringy flesh
36539	5	5	5	5	20	**Acceptable**
36615	2	1	1	1	5	**Reject:** tart & dark with stringy flesh
36728	5	3	1	3	12	**Reject:** unpleasant flavour
36894	5	5	5	4	19	**Acceptable:** texture softer side of firm
36937	5	5	1	2	13	**Reject:** tart with soft flaking skin
37205	5	3	1	2	11	**Reject:** tart & soft
37300	5	5	5	2	17	**Acceptable:** but soft
37331	3	5	4	1	13	**Reject:** soft, peeling skin
37349	2	3	1	2	8	**Reject:** stringy flesh & flakey skin
37356	5	3	5	1	14	**Acceptable:** but soft, peeling skin

Table 3 Continued. Assessment scores for the quality of canned fruit of apricot breeding line selections assessed in the 2014/15 season. Scores are average of 4 experienced assessors with individual attributes judged out of 5 (where 1-poor/soft, 3-good, 5-excellent/firm) and total is sum of the attribute scores (out of 20).

Selection	Assessment scores for characteristics of canned fruit					Comments
	Juice	Colour	Flavour	Texture	Total	
37388	5	1	1	2	9	**Reject:** soft, tart and dark
37440	5	5	5	1	16	**Acceptable:** good but soft with peeling skin
37448	5	5	5	3	18	**Acceptable:** good but smaller fruit and flaking skin
37473	1	3	1	1	6	**Reject:** soft, falling apart, tart, cloudy juice, inconsistent colour
37612	5	3	2	3	13	**Acceptable:** flat flavour, pale colour
37890	5	5	1	1	15	**Reject:** soft, peeling skin and tart
37986	5	1	2	5	15	**Reject:** bland and dark

2015/2016 Season

Fruit set for the 2015/16 season was good and regarded as above average overall. This followed an average season in 2014/15 with many lines experiencing consecutive seasons of high cropping which is encouraging. Winter chilling was 1237 Richardson-Utah Chill units, 20% above average and the second highest recording in the past 19 years for Loxton Research Centre. Accumulation began normally, rising rapidly for an extended period before some minor warm weather events slowed accumulation towards the end. Good progress through the middle range and mild conditions without major warming periods rendering what occurred effective.

Significant periods of the pollination were favorable with visible bee activity for critical periods. Breeding program fruit sets were generally very good and comparable to, if not better than those of the industry generally in the Riverland. For the second year in a row some issues were experienced with earwigs damaging flowers during pollination, it remains to be seen if this will be an ongoing phenomenon requiring baiting or chemical control. Good early winter rain was replaced by extended dry conditions over mid and late winter leading to drier than expected sub-soil moisture levels which needed to be offset by earlier irrigation. Fruit development and ripening was helped by warm to hot conditions free from significant rain events leading to excellent fruit quality.

In total during the 2015/16 season 42 apricot samples were harvested for canning evaluation at SPCA. An initial batch of 34 apricot samples was sent to SPCA (14/12/15) for trial canning, pre-transport and post canning assessment results can be seen in Appendix Tables 4 & 5 respectively. A more detailed discussion of the season's results is also available in the Appendix accompanying these tables. Two lines 34769 and 35213 were represented by two samples from different source trees, both 34769 samples passing and both 35213 samples being rejected.

A second batch of 7 samples were sent to SPCA (12/1/16) however these subsequently became frozen in storage at SPCA and were unsuitable to be processed.

Another sample, line 30607 harvested 27/11/15 was not sent for trial canning due to significant marking and bronzing making it unsuitable for processing.

SPCA deemed the best performing lines this season to be line 29110 (15 points), followed by, 34769, 35209, 36341, 37612 (14 points) and 24086 and 37356 (13 points)

Overall, 10 lines produced acceptable products worthy of further consideration. These were with post canning assessment points recorded in brackets, 15742(12), 25086(13), 29110(15), 34769a(14), 34769b(12), 35209(14), 36341(14), 37356(13), 37612(14) and 37552(11). These lines will be grafted to provide trial trees to SPCA for further evaluation, with the exception of line 36341 which appears to produce more delicate and bruise prone fruit and have suspect lower cropping levels. Due to this it has been removed from the program on agronomic grounds.

Line 34769a and 34769b were harvested from trees with a very heavy crop and advanced canning maturity (14 points) and moderately heavy crop and very advanced maturity (12 points) respectively. It appears quality may be impacted by further advancement in maturity of this line which is expected with most lines. Lines 15742 (12) and 16222 (8) are very similar and have canned well over previous years it is unknown why their canned assessment was significantly different this season given samples of very similar fruit were harvested on the same day (9/12/15) in the same location. Line 37752 has been include despite scoring only 11 points, it is a clean line, only noted as having variable maturity from an over-cropped source rather than more terminal characters like tart or off flavours. Hence it may be wise to give it some further consideration before removing it from contention as a processing line.

Notably this season a "Bounty" (Line 3444) sample harvested 27/11/15 scored only 9 points and was noted as having moderate to severe marking. Weather at the time was very hot and it is likely this sample had weather and chilling injury which probably contributed to its low score and variable texture on processing.

Table 4: Harvest date, maturity rating, crop load on tree and characteristics of fresh fruit of apricot breeding line selections assessed for canning in the 2015/16 season.

Selection	Harvest date	Maturity Rating	Crop load	Characteristics of fresh fruit				
				Size	Texture	Ground Colour	Blush	Quality and specific defects
3444	27/11/15	C	Heavy	Large	Medium	Green/Light Orange	Very Slight	Suspect-fruit with moderate to severe marking, appears to have been picked hot
11353	4/12/15	C+	Heavy	Large	Firm	Light Orange	Slight	Ok-relatively clean, odd suture crack
15742	9/12/15	C+	Heavy	Large/Very large	Firm	Orange	Slight to Moderate	Ok- slight marking, slightly uneven, green striping of suture
16222	9/12/15	C	Heavy	Large/Very large	Firm	Orange	Slight to Moderate	Good- minor marking
19880	2/12/15	C++	Heavy	Medium	Very Firm	Yellow/ Light Orange	Slight	Excellent- clean
22926	2/12/15	C+	Very Heavy	Small/Medium	Medium	Light Orange	Moderate	Ok- minor marking, odd suture crack, tough skin
23361	23/11/15	C+	Heavy	Medium/Large	Medium	Light Orange	Slight to Moderate	Ok- slight marking, odd suture crack, tough skin
24086	2/12/15	C	Heavy	Small/Medium	Very Firm	Orange	Very Slight	Excellent- very firm, full colour, even, clean, good looking
24498	9/12/15	C+	Heavy	Medium/Large	Medium	Orange	Moderate	Ok-no marking but quite blushed
29110	9/12/15	C	Heavy	Large	Very Firm	Light Orange	Very Slight	Excellent- large, firm, clean, retains stems
34124	27/11/15	C+	Heavy	Medium/Large	Medium	Light Orange	Slight	OK- looks like it may bruise
34769(a)	27/11/15	C+	Very Heavy	Large	Very Firm	Light Orange	Slight to Moderate	Ok- minor marking, rubbery, green shoulders
34769(b)	23/11/15	C++	Moderately Heavy	Large	Very Firm	Orange	Very Slight	Good- no marking, rubbery, good colour
35094	25/11/15	C	Heavy	Medium/Large	Very Firm	Orange	Very Slight	Ok- minor marking, firm but speckled skin

Table 4 Continued: Harvest date, maturity rating, crop load on tree and characteristics of fresh fruit of apricot breeding line selections assessed for canning in the 2015/16 season.								
Selection	Harvest date	Maturity Rating	Crop load	Characteristics of fresh fruit				
				Size	Texture	Ground Colour	Blush	Quality and specific defects
35209	25/11/15	C to C+	Heavy	Medium	Firm	Orange	Slight to Moderate	Ok- clean and firm but variable maturity and egg shaped
35213(a)	25/11/15	C	Heavy	Medium/ Large	Firm	Orange	Slight to Moderate	Good- firm, minor marking with slightly speckled skin
35213(b)	25/11/15	C++	Very Heavy	Medium	Firm	Orange	Slight to Moderate	Ok- Clean, slightly specked skin but advanced maturity
36341	2/12/15	C+	Light Moderate	Small/ Medium	Medium	Deep Orange	Nil	Ok- few marks, may bruise, suspect cropping
36443	17/11/15	C++	Heavy	Medium/ Large	Firm	Light Orange	Nil	Very good- Clean, even
36480	17/11/15	C	Very Heavy	Small	Firm	Light Orange	Slight to Moderate	Ok- minor marking and over-cropped
36539	4/12/15	C	Heavy	Medium/ Large	Very Firm	Orange	Slight to Moderate	Good- Clean and very firm
36546	9/12/15	C	Moderate	Very Large	Medium	Light Orange	Slight	Ok- very large and lumpy
36557	10/12/15	C	Heavy	Large	Very Firm	Light Orange	Slight	Ok- marks moderately
36605	4/12/15	C	Very Heavy	Small	Very Firm	Yellow/ Light Orange	Moderate to Heavy	Suspect- probably too much blush
36956	23/11/15	C	Very Heavy	Small	Very Firm	Yellow/ Light Orange	Slight	Ok- over-cropped tree
37232	25/11/15	C	Very Heavy	Medium	Firm	Light Orange	Slight	Good- clean with very free stone
37356	23/11/15	C+	Very Heavy	Small	Firm	Orange	Slight to Moderate	Ok- over-cropped tree
37404	2/12/15	C to C+	Heavy	Very Large	Medium	Light Orange	Very Slight	Suspect- pebbly, marks and bruises

Table 4 Continued: Harvest date, maturity rating, crop load on tree and characteristics of fresh fruit of apricot breeding line selections assessed for canning in the 2015/16 season.								
Selection	Harvest date	Maturity Rating	Crop load	Characteristics of fresh fruit				
				Size	Texture	Ground Colour	Blush	Quality and specific defects
37422	11/12/15	C-	Heavy	Medium	Very Firm	Yellow/ Light Orange	Moderate to Mod. Heavy	Suspect- probably too much blush and some quite green
37448	4/12/15	C+	Light Moderate	Small	Very Firm	Orange	Very Slight	Suspect- moderate to severe marking and some shrivel
37551	23/11/15	C++	Very Heavy	Medium	Very Firm	Light Orange	Slight to Moderate	Excellent- clean and very firm
37612	9/12/15	C	Very Heavy	Medium	Firm	Orange	Very Slight	Ok- minor blemish, variable maturity
37752	2/12/15	C to C+	Very Heavy	Medium	Firm	Orange	Slight	Ok- moderate blemish, mostly rub and variable maturity variable maturity
37756	2/12/15	C+	Very Heavy	Medium	Medium	Orange	Slight to Moderate	Good- clean

Table 5: Assessment scores for the quality of canned fruit of apricot breeding line selections assessed in the 2015/16 season. Scores are average of 4 experienced assessors with individual attributes judged out of 5 (where 1-poor/soft, 3-good, 5-excellent/firm) and total is sum of the attribute scores (out of 20).

Selection	Assessment scores for characteristics of canned fruit					Comments
	Appearance	Colour	Flavour	Texture	Total	
3444	3	2	2	2	9	**Reject:** Mixed texture
11353	2	3	3	2	10	**Reject**
15742	3	3	3	3	12	**Acceptable**
16222	2	1	3	2	8	**Reject:** dull colour
19880	3	3	2	2	10	**Reject**
22926	3	3	3	2	11	**Reject:** fibrous, mixed texture
23361	2	3	1	2	7	**Reject**
24086	4	3	3	3	13	**Acceptable**
24498	3	3	2	2	10	**Reject:** mixed texture
29110	4	4	3	4	15	**Acceptable:** very good
34124	2	3	3	2	10	**Reject**
34769(a)	4	3	3	4	14	**Acceptable:** firm with good size
34769(b)	3	4	3	2	12	**Acceptable:** soft
35094	2	4	2	1	9	**Reject:** soft
35209	4	3	4	3	14	**Acceptable:** good flavour
35213(a)	2	2	2	1	7	**Reject:** soft
35213(b)	3	3	3	2	11	**Reject:** dark orange, mix of soft & firm
36341	4	3	3	4	14	**Acceptable:** held up well
36443	2	2	2	1	7	**Reject:** soft texture, tart flavour
36480	3	2	2	3	10	**Reject:** small fruit
36539	3	3	2	1	9	**Reject:** soft
36546	3	2	2	3	10	**Reject:** large fruit, mixed texture
36557	2	3	2	3	10	**Reject:** dull colour and size variable
36605	3	2	2	3	10	**Reject:** tart with dull colour
36956	4	3	1	3	11	**Reject:** tart with small fruit

Table 5 continued: Assessment scores for the quality of canned fruit of apricot breeding line selections assessed in the 2015/16 season. Scores are average of 4 experienced assessors with individual attributes judged out of 5 (where 1-poor/soft, 3-good, 5-excellent/firm) and total is sum of the attribute scores (out of 20).

Selection	Assessment scores for characteristics of canned fruit					Comments
	Appearance	Colour	Flavour	Texture	Total	
37232	2	2	2	1	7	**Reject:** tart
37356	4	2	3	4	13	**Acceptable:** small fruit, dull colour
37404	1	2	2	1	6	**Reject:** too soft to can, large fruit, tart
37422	4	2	2	4	9	**Acceptable:** firm with good size
37448	2	2	2	2	8	**Reject**
37551	1	1	1	1	4	**Reject:** very mushy
37612	4	3	3	4	14	**Acceptable:** small fruit
37752	3	3	2	3	11	**Acceptable:** tough skin
37756	2	3	2	1	8	**Reject:** tart with soft fruit

Table 6: Average agronomic information for the identified canning apricot lines of interest. Sizes in brackets are "largest" average annual recording. ? reflects a level of uncertainty in the determination. Data is from trees grown at the Loxton Research Centre.

Line	Maturity	Cropping	Firmness	Weight (gm)	Size (mm)	TSS (Brix)	Self Fertility	Average Bloom
36480	15 Nov	Very Heavy	Firm	43	44 (46)	17	+	5 Sept
37356	26 Nov	Heavy	Very Firm	45	46 (54)	19	+	10 Sept
35209	29 Nov	Heavy	Very Firm	61	49 (52)	18	+	31 Aug
34769	1 Dec	Heavy	Firm	66	51 (57)	19	+	5 Sept
37752	3 Dec	Heavy	Firm	53	50 (54)	20	+	2 Sept
36894	5 Dec	Moderate	Firm	44	47 (48)	21	+?	11 Sept
24086	6 Dec	Moderately Heavy	Very Firm	57	48 (51)	20	-?	8 Sept
32255	6 Dec	Light Moderate	Moderately Firm	44	44 (51)	22	+	30 Aug
36539	7 Dec	Moderately Heavy	Very Firm	54	49 (52)	23	-?	1 Sept
29110	10 Dec	Moderately Heavy	Very Firm	56	50 (56)	23	+	2 Sept
37612	10 Dec	Moderately Heavy	Firm	50	47 (50)	22	+	17 Sept
3444	11 Dec	Moderately Heavy	Moderately Firm	78	52 (59)	14	-	30 Aug
15742	13 Dec	Moderately Heavy	Firm	97	60 (62)	17		9 Sept
23547	18 Dec	Moderate	Very Firm	46	47 (51)	22	+	12 Sept