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Pomegranate, The NEW Discovery in Commercial Health Foods

Robert Jamieson

2013 AgriFoods Skills Australia International Fellowship

An ISS Institute Fellowship sponsored by

AgriFoods Skills Australia

ISS Institute Inc

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i. Executive Summary

History reveals the origins of the pomegranate fruit come from Arabia and Persia. From here it spread to Turkey and surrounding regions. Very little has been recorded about production methods in these traditional growing regions. This Fellowship study trip allowed Jamieson to experience firsthand the production methods used in these traditional growing countries. Their skills have been developed over hundreds of years growing this plant and this information has been handed down from generation to generation.

While Israel may be a relatively new pomegranate growing region, it is achieving excellent crop yields in remote areas with limited water resources. Study of their production methods has provided valuable knowledge on irrigation design and water application methods.

Research and observation in both international locations has provided a comparison in production methods from the traditional locations to the modern approaches of Israel.

From the study of these regions the Fellow has become better informed on the best way to develop a 'best practice' production system for the Australian development of a pomegranate industry.

Having established a 20,000 tree organic certified olive grove in Central Victoria, Jamieson turned his attention to identifying other crops that should be investigated to meet the climate change challenge and which would require a reduced reliance on high water consumption crops.

The development of new crop industries is important for the future of Australian agriculture. Jamieson's contribution in identifying new potential crops and developing a best practice plan for this crop may enable other farmers to introduce this crop into their farming mix with confidence and low risk.

The Fellow's acquired knowledge will be presented in a report and will be available via the ISS Institute website. He will seek to work with agriculture organisations to promote the opportunities of becoming involved in the Pomegranate Industry.

This focused overseas study trip enabled the Fellow to develop a best practice model for pomegranate production in Australia.

Pomegranate (punica granatum) fruit has been grown since the beginning of recorded history and holds a traditional role as a fruit in many community and religious groups:

- In Greek mythology - represents life, regeneration and marriage
- In Persian mythology - Isfandyar (Persian hero) eats a pomegranate and becomes invincible
- In Judaism - pomegranate seeds are said to number 613, one for each of the 613 commandments in the Old Testament
- In Buddhism - one of the blessed fruits representing the essence of favourable influences
- In China - used in ceramic art symbolising fertility, abundance, prosperity and a blessed future
- In Christianity - a symbol of resurrection and eternal life
- In Islam - the heavenly paradise of the Koran describes four gardens and fruits, including the Pomegranate
- Pliny - considered Pomegranates to be among the most valuable of ornamental and medicinal plants

i. Executive Summary

- Theophrastus - provided an early description about 330 years before the Christian era
- Legend also says the pomegranate was the “tree of life” in the Garden of Eden and became the symbol of hope and eternal life in early Christian art
- The erect calyx-lobes of the fruit were the inspiration for Solomon’s crown and all future crowns
- Pomegranate is a fruit prized for its colour and flavour, it is easy to harvest, stores well and provides a high nutritional value food.

Right: Pomegranate fruit tree

Below: Pomegranate fruit cut open

The New Discovery!

The nutritional value of the pomegranate has only been researched recently and a large amount of documentation now supports it being classified as a "super rich nutrient food", also called functional foods.

Pomegranate fruit is high in poly-phenols and potent antioxidants, in particular tannins, anthocyanins and ellagic acid. Antioxidants are now credited with helping in the prevention of various cancers and heart disease.

Research has been undertaken in the following areas:

1. Tezcan et al 2009, clinical studies suggest that pomegranate juice increases the activity of serum high-density lipoprotein (HDL) and decreases low-density lipoproteins (LDL) susceptibility to aggregation and oxidation.
2. Al-Zoreky 2009, pomegranate juice exhibits strong activity against some species of bacteria, which justifies its use as a biopreservative in food.
3. Pantuck et al 2006, showed pomegranate juice consumption helps keep prostate specific antigen (PSA) levels stable in men and even slows its increase by extending the PSA doubling time.
4. Aviram et al 2008, showed pomegranate juice is helpful against heart disease.
5. Seeram et al 2007, showed pomegranate juice is helpful against prostate and colon cancers.
6. Forest et al 2007, reported improvement in erectile dysfunction in male patients.
7. Aviram and Dornfeld 2001, showed pomegranate juice reduced systolic blood pressure.

The health benefits attributed to the consumption of fruits are related at least in part to their antioxidant activity. The antioxidant properties of fresh pomegranate juice extraction are measured as Total Phenolic Compounds (TPC) expressed as Gallic Acid Equivalent (GAE).

Interesting research is also being done into which extraction method produces the highest nutritional value. Current indications are that the traditional method of whole fruit crushing yields highest value, but also generates the more bitter tasting juice.

Pomegranate fruit juice has become the new health drink.

Australia has not developed an industry in pomegranate production unlike other countries where large areas of plantings have been developed to supply the unmet demand for pomegranate fruit.

Currently, Australia has just over 250 hectares of commercial pomegranate plantations. Predictions are that this could increase to 1,000 hectares producing $A50 million in produce value (Eccles, 2008).

To enable an accurate comparison of the Australian investment in pomegranate production compared to other counties - the current planting data from various international locations is as follows:

Commercial pomegranate plantations (2008):

Iran	65,000 hectares	Turkey	8,000 hectares	USA	6,000 hectares.
India	55,000 hectares	Israel	1,500 hectares		

(SOURCE: Ed Stover, USDA, University California, Davis, California)

Even more significant than these numbers, is the fact that both America and India have increased their production dramatically between the two dates.

More recent data 2010 shows USA is up to 10,000 hectares, and India has more than doubled, up to 125,000 hectares

(Source: Ed Stover, USDA, University of California, Davis, California)

Global production figures (2008):

India	500,000 tonnes
Iran	600,000 tonnes
USA	110,000 tonnes
Turkey	90,000 tonnes
Israel	17,000 tonnes

(Holland and Bar-Ya'akov, 2008).

Currently there is no pomegranate industry body in Australia to support this industry and very little research and development has been done to encourage the development of a pomegranate industry.

The Rural Industries Research and Development Corporation (RIRDC), an Australian Government body, have produced two papers - RIRDC 08/153 and RIRDC 09/165. Both state high potential for this crop with low set up costs, low water use and low human input required.

However, the RIRDC have identified more research is needed if this crop is to be established in Australia.

Currently, commercial plantations in Australia have relied on overseas consultants to provide the advice on plantation development, as there has been little Australian expert knowledge to act as advisers or consultants on this crop.

Australian farmers who may be considering Pomegranate production, must act now and not miss the opportunity to become a global player in this market. One outcome of this focussed Fellowship research trip has enabled the Fellow to develop a best practice model for pomegranate production in Australia.

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ii. Abbreviations/Acronyms

Aril	Membrane covered seeds within pomegranate
BD	Biodynamic Certification
BFA	Biological Farmers Association
CEO	Chief Executive Officer
Degrees C	Centigrade Temperature
GAE	Gallic Acid Equivalent
LDL	Low Density Lipoproteins
Ha	Hectares
HDL	High Density Lipoproteins
IPGRI	International Genetic Resources Institute
ISS	International Specialised Skills Institute
Ltr	Litre
MAP	Modified Atmosphere Packing
NRIA	New Rural Industries Australia
PSA	Prostate Specific Antigen
RIRDC	Rural Industries Research and Development Corporation
TPC	Total Phenolic Compounds
WHO	World Health Organization

1. Acknowledgements

Robert Jamieson would like to thank the following individuals and organisations who gave generously of their time and their expertise to assist, advise and guide him throughout the Fellowship program.

Awarding Body – International Specialised Skills Institute (ISS Institute)

The International Specialised Skills Institute Inc is an independent, national organisation that for over two decades has worked with Australian governments, industry and education institutions to enable individuals to gain enhanced skills and experience in traditional trades, professions and leading-edge technologies.

At the heart of the ISS Institute are our Fellows. Under the **Overseas Applied Research Fellowship Program** the Fellows travel overseas. Upon their return, they are required to pass on what they have learnt by:

1. Preparing a detailed report for distribution to government departments, industry and educational institutions.
2. Recommending improvements to accredited educational courses.
3. Delivering training activities including workshops, conferences and forums.

Over 200 Australians have received Fellowships, across many industry sectors. In addition, recognised experts from overseas conduct training activities and events. To date, 22 leaders in their field have shared their expertise in Australia.

According to Skills Australia's 'Australian Workforce Futures: A National Workforce Development Strategy 2010':

> Australia requires a highly skilled population to maintain and improve our economic position in the face of increasing global competition, and to have the skills to adapt to the introduction of new technology and rapid change.
>
> International and Australian research indicates we need a deeper level of skills than currently exists in the Australian labour market to lift productivity. We need a workforce in which more people have skills, but also multiple and higher level skills and qualifications. Deepening skills across all occupations is crucial to achieving long-term productivity growth. It also reflects the recent trend for jobs to become more complex and the consequent increased demand for higher level skills. This trend is projected to continue regardless of whether we experience strong or weak economic growth in the future. Future environmental challenges will also create demand for more sustainability related skills across a range of industries and occupations.

In this context, the ISS Institute works with Fellows, industry and government to identify specific skills in Australia that require enhancing, where accredited courses are not available through Australian higher education institutions or other Registered Training Organisations. The Fellows' overseas experience sees them broadening and deepening their own professional practice, which they then share with their peers, industry and government upon their return. This is the focus of the ISS Institute's work.

For further information on our Fellows and our work see http://www.issinstitute.org.au.

1. Acknowledgements

Fellowship Sponsor

AgriFood Skills Australia is the Industry Skills Council for the agrifood industry: the rural and related industries, food processing (including beverages, wine and pharmaceuticals), meat, seafood and racing. The Fellow would like to thank them for providing funding support for this Fellowship.

Fellowship Supporters

Individuals/organisations/companies involved in developing the overseas program in Australia:

- Sir James Gobbo AC, CVO, Founder & Board Member, ISS Institute
- Bella Irlicht AM, CEO, ISS Institute
- Mr Paul Miller, President, New Rural Industries Australia (NRIA)
- Sam Birrell Agronomist, Netafim Irrigation
- David King, Farm Manager, Percydale Estate
- John Messina, Technical Officer, Sunraysia Nurseries.

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- Sue Jamieson, for unscrambling notes and writings to compile this report.

Individual/organisations involved in the actual Fellowship research in Israel:

- The Australia/Israel Chamber of Commerce, Mr Paul Israel, CEO Israel and Mr Leon Kempler, CEO Australia
- Mr Itay Aztmon, Agronomist, Israel
- Mr Ilan Cohen, Moshav Sde Ya'acov, Northern Israel
- Mr Meir Lipshitz, Kibbutz Sde Eliyahu, Beit Shean Valley
- Mr Avner Galili, CEO Juran Industries, Rishon Lezion
- Dr Doron Holland, Volcani Institute, Newe Ya'ar
- Dr Ron Porat, Volcani Institute Beit Dagan.

In Turkey:

- Mehmet Daldal, CEO, Narice Industries, Aydin
- Elcin Yilmaz, Professional Guide
- Alper Akman, GM, Em Agriton.

2. About the Fellow

Name

Robert Jamieson

Director, Capital & Agriculture Management Pty Ltd

Project Manager of Percydale Estate (120 Hectare organic vineyard and olive grove)

Researcher of Pomegranate production with a 200 tree trial plot.

Qualifications

Bachelor of Pharmacy, Victoria, 1971

Post Graduate Diploma Homeopathic, 1982

Post Graduate Diploma Nutritional Medicine, 1987

Memberships

Member Pharmaceutical Society Australia (PSA)

Fellow Australian Institute of Pharmaceutical Management (FAIPM)

Associate Member, Australian College of Nutritional & Environmental Medicine (ACNEM)

Agricultural Radionics Practitioner

A third generation vineyard owner, who qualified as a Pharmacist, owned and conducted a community Pharmacy for 25 years before returning to the land.

With a post graduate qualification in Nutritional Medicine and a keen interest in sustainable agriculture Jamieson has applied himself to developing a farm based on these principles.

'Percydale Estate' located in Pyrenees Region, Central Victoria, Australia is registered with the Biological Farmers Association (BFA) as Organic and Bio-dynamic producer (BFA 1242BD).

After research into Olive grove production in the early 1990s following the publication of a WHO paper detailing the health benefits of olive oil in the diet (now known as the 'Mediterranean Diet'), Jamieson developed a 12 Ha research olive farm in 1995 before progressing to a 80 Ha olive grove in 2000.

3. Aims of the Fellowship Program

The aim of the Fellowship was to enable a comparative understanding of pomegranate production in various areas in the world via the following objectives:

- To acquire knowledge on how pomegranates have been propagated and grown in the traditional growing areas of Turkey
- To understand how highly developed irrigation systems have produced commercial crops of pomegranates in arid regions of Israel
- To study modern pomegranate plantation design in both these countries
- To study fruit storage and value adding to pomegranate production such as post-harvest storage requirements for fruits and juice and the development of a variety of pomegranate products currently available to consumers
- To develop a best practice model of commercial pomegranate production for Australian conditions.
- To fill this industry skills gap in Australia and to provide a knowledge pathway for others to follow to join this industry to provide a crop suited to climate change in Australia and in a growth industry worldwide.

To ensure these aims were achieved, Jamieson visited farms, processing Industries and academics recognised as experts in their field.

There is a saying,

'an hour spent talking with a successful person in their chosen field

is worth a year of study on your own'.

This was a true experience for this Fellow.

4. The Australian Context

Pomegranate production in Australia is still largely at the cottage industry stage.

It requires the development of a direction, a model system and an industry structure similar to what the Olive Industry in Australia has gone through since 1994.

It was over the last three years while researching pomegranate production that the Fellow discovered very little research had been conducted in Australia into the development of pomegranate production as a new industry.

Several large plantations have been developed in Australia with the remaining being small holdings. Australia needs to provide support and encouragement for other farmers to add pomegranates to their farming mix to create sufficient volume of fruit to develop a sustainable industry.

Australia has the advantage of becoming a southern hemisphere producer selling into the European market during the counter season time period. As this fruit travels well there is a huge opportunity to develop a premium product supply chain during this off-season period into an already established market that is currently under supplied

This Fellowship enabled the development of a best practice model for the implementation of a Pomegranate Grove into an existing Mixed Framing Enterprise, or as a stand-alone Commercial Pomegranate plantation – **See Appendix 1**.

However, during research preparation for this Fellowship a situation was discovered that could have significant impact on the Strengths, Weaknesses, Opportunities and Threats (SWOT) compiled for this report – **see Appendix 3**. This situation must be taken into account when considering any future investment in Pomegranate production.

SWOT ANALYSIS

Strengths:

- Climatic conditions are suitable, hot dry summers and cold wet winters
- Mixed farms have under-utilised land which could be suitable for a pomegranate grove
- Low water demanding crop
- Low input of human power
- Australian harvest time is counter seasonal to northern hemisphere
- High value crop with a worldwide demand currently unmet
- A fruit that travels well and stores well
- World market established with considerable information on health claims
- Pomegranate fruit has a wide range of uses
- Good horticultural knowledge exists in Australia.

Weaknesses:

- Currently only small total planting area in Australia
- Lack of fruit volume to establish a vertical integrated production system
- Low domestic consumer awareness of health properties
- Low domestic consumer consumption demand currently

4. The Australian Context

- Current domestic market small
- Difficult fruit to open for consumption
- High labour costs for harvest time with hand harvesting
- Limited expertise and information on pomegranate production in Australia
- No industry body or market development body.

Opportunities:

- To provide the fruit into the Northern Hemisphere during their out of season period
- Tapping into a market which has an unmet demand for fruit world wide
- Adding a high value crop to existing farming mix
- Replacing high water usage crops with low water consumption crop
- Adjusting farm mix to address climate change effects
- Mechanical aril extraction methods are a recent development providing low labour costs as opposed to traditional methods incurred high labour costs
- Mechanical juice extraction equipment now available
- Replace imported fruit with local fruit
- Health driven fruit products.

Threats:

- Not attracting production volume to become a highly economic opportunity
- Not getting the vertical integration model viable to ensure a profitable crop
- Not applying the best practice model to develop a highly productive use of land
- Not having the skills to produce a high quality crop
- Harvesting is currently a manual process exposing the operation to high labour costs if product prices decrease significantly
- A disease condition has developed in some groves in Australia that have caused trees to suddenly die and as yet research on this problem has not yet revealed a cause. Appendix 3 outlines what is known about this disease at this time.
- Increased production in overseas countries may create shrinking market opportunities
- Overseas countries access to cheap labour costs.

5. Identifying the Skills and Knowledge Enhancements Required

There are examples of areas in Australian industries where there are weaknesses in innovation, skills, knowledge, experience, policies and/or formal organisational structures to support the ongoing successful development and recognition of individuals and the particular sector.

The focus of all ISS Institute Fellowships is on applied research and investigation overseas by Australians. The main objective is to enable enhancement and improvement in skills and practice not currently available or implemented in Australia and the subsequent dissemination and sharing of those skills and recommendations throughout the relevant Australian industry, education, government bodies and the community.

There are currently only several commercial large-scale pomegranate groves in Australia. Many smaller cottage industry size groves have been planted over the last few years. There is no industry body coordinating activities of marketing and research.

The following outlines the skill and knowledge enhancement areas that were addressed during the Fellowship:

- Study and gain a better understanding of soil types, site locations and growing environment
- Study first hand the tree structure development with and without trellis systems
- On site examination of fruit thinning and fruit layout on tree
- Study irrigation systems employed in modern groves
- Investigate post-harvest handling, sorting and grading systems
- Investigate post-harvest transport and storage systems
- Brand development and marketing of fruit and other products.

The areas of applied research for this Fellowship are therefore defined as follows:

- Investigate and record pomegranate tree structure in Turkey where methods of pruning and shaping trees have been refined over hundreds of years
- Review micro-irrigation systems utilised in Israel and compare cost benefits of the dripper line verses micro sprinkler systems
- Compare modern practice methods used with traditional production methods and develop a best practice model for Australian conditions.

Action

Design the optimal grove lay-out configuration with focus on tree density, row spacings and head land clearance.

Detail findings on micro irrigation design and water efficiency.

Action

Based on the research, recommend tree shaping structure alternatives, pruning methods for optimum crop yields and foliage density for best fruit colour.

Action

From the observation and comparison of traditional and model farming practices, develop a model for a cost effective development and maintenance plan for farmers wishing to integrate pomegranate production into their farming mix.

6. The International Experience

Destination 1: Organic Expo, Izmir, Turkey

At this Expo several stands were related to pomegranate production. The Narice stand provided tastings of their pomegranate juice and associated products. This was a good introduction to a meeting planned with Narice CEO, Mehmet Daldal.

At the meeting, he provided an insight to the strict adherence to quality control throughout all stages of production from fruit arrival to end juice product for consumer confidence and health safety concerns.

Narice pomegranate juice was targeted to the high end of consumer demand. The fruit separated arils from skin prior to crushing so to avoid the tannin taste normally associated with fresh crushed juice. This was a conscious decision; while an expensive process, it enabled them to differentiate their juice from others on the market and in doing receive a premium price for a more sweet delicate flavoured juice.

Narice juice production involved a rapid frozen process to minus 18 degrees Celsius post bottling and held at this temperature up until consumer purchase when it should be thawed and consumed within seven days. No additives are added to this product.

Narice juice frozen tastes as fresh and sweet when thawed as if freshly crushed, even after six months. There is a distinct lack of tannin taste in Narice juice as a result of the production system.

Destination 2: Heritage Pomegranate Farm, Izmir, Turkey

The Fellow travelled inland to a region where pomegranates have been farmed for a very long period of time. Here there were many new plantings of large areas which had had old plantings removed.

The new plantings were on a five by three metre grid. The trees were single trunk and then three to four branches in a vase shape. No trellis system was used, just free-standing trees.

New plantings, Turkey

The plantings were on raised beds and mid rows cultivated clean. Irrigation was provided by two dripper lines, one each side of the tree. In some groves there had been attempts to cover dripper lines with soil or compost.

Old tree plantings were not seen in large groves but occasional clusters near buildings or on less productive areas of the properties.

Pomegranate Pom Tree

Several of these trees were studied to increase understanding of what characteristics older trees acquired.

Destination 3: Operational kibbutz Pomergrante Farm, Israel

In Israel the plan was to visit three kibbutzes in different parts of the country. The first farm visit was a moshav, which is a collective of individually owned farms being farmed as a single unit.

This farm had a very sophisticated trellis system designed by Atay Atzmon (a consultant Agronomist) who accompanied the Fellow to various groves and gave a first hand in field account of the issues he wanted to address and the methods he had undertaken in attempt to resolve those issues.

He has a model one and a model two system set up. Both systems had an amazing amount of new fruit set post flowering. Model two systems had raised the height of the trellis and extended the trellis arms further out to spread the growth wider and to allow harvest at a more convenient height.

This particular system was a labour intensive operation where considerable time is spent pruning, trellising the branches with tie-downs to provide a uniform foliar canopy spread both into the rows and towards the adjoining tree.

Atzmon's goal was to have a uniform foliar coverage tree to tree with no gaps, with a wide spread of foliage into the row space. This was to ensure the fruit set was below the trellis system and provide protection from sunburn and reduced risk of fruit damage from abrasion.

The crop yields were equally amazing. They thinned the fruit after set to single fruits not clusters. Fruit exposed to sunburn or rubbing was removed and final yield aimed for about 150 fruits per tree.

The resulting tree shape provided a protective foliar canopy with the limbs supported on the trellis wires and allowed the fruit to hang below the trellis wire, protected from sunburn and reducing the potential of the skin being scratched. Their primary focus was to produce export class whole fruits. This is where the price premium market exists, any second class fruit went to juice or wine production.

Israel Atzmon trellis

Destination 4: Juran Industries, Rishon, Tel Aviv

Juran Industries in the Rishon Lezion near Tel Aviv have developed the first patented aril extraction machine, which mechanically removes the arils from the skin and membrane without damage to arils.

Mr Avner Galili, CEO of the company, discussed his views and vision for the pomegranate industry.

The mechanised processing now plays a significant part in reducing the cost of processing the fruit which up until now was a very labour intensive and costly manual extraction process.

The Fellow was shown videos of their equipment operating in factories around the world and provided with a detailed explanation of the key features of the system.

Mr Galili's belief is that the high quality of the end product will determine the market potential. He also was of the opinion that with equipment such as his would open opportunities in countries such as Australia where labour costs were expensive and to allow those countries to be internationally competitive producers.

Destination 5: Sde Eliyahu kibbutz, Beit Valley, Jordan Border

A trip north-east to the kibbutz Sde Eliyahu (an organic agriculture farm) near the Jordan border in the Beit Shean valley was then undertaken.

It was here that Meir and Eli showed Jamieson their 40-year old pomegranate grove, where minimum input of labour or materials had developed very natural growing trees.

They kept the height of the trees controlled below the netting roof but they did not shape or trim the trees, as free growing was the normal approach. Some trellis was used as single wire but this appeared to be more for irrigation line support now the trees were mature.

The farm also includes a large compost production business and had the advantage of access to this product.

The Kibbutz is also the home of a large production house for insect breeding program and now commercially produces 'Bio Bee Biological Systems' as an alternative to using pesticides on farms. They breed pirate or beneficial bugs that control pests in specific crops.

Unfortunately the Fellow was unable to obtain production yield numbers for this farm as it appeared they harvested whatever was produced and then sold everything available each season.

"Fellow inspecting Ripening fruit at the Sde Eliyahu kibbutz"

Destination 6: Volcanic Research Institute, Bet-Dagan, Israel

The Fellow went to the Volcani Research Institute, Bet-Dagan where a meeting with Dr Ron Porat at the department of post-harvest science was held.

A presentation was delivered on the research that had been conducted into best practice post-harvest storage and processing of pomegranates.

A short summary from this presentation is:

- Fruit must be harvested by cutting not pulling fruit from tree
- Post-harvest handling of the fruit must be gentle and minimum
- Storage from rain was important
- Rapid chilling was critical.

Two processes were highlighted:

1. The first method used was Modified Atmosphere Packing (MAP) where various combinations of oxygen and carbon dioxide were used, together with low temperature control.
2. The second method used was storage in special polymer bags maintained at a temperature of 7.2 to 7.5 degrees Celsius. After two days the bags are sealed. This method allowed premium fruit to be stored for up to three months without shrinkage or spoilage.

The special polymer bag is also an Israeli invention, marketed by Step Pac Ltd in Israel and is now commercially available. Different cultivars of fruit do exhibit slightly different requirements and some slight alteration to this standard method may be required.

Dr Porat with Fellow

Destination 7: Moshav Community Farm, Sde Ya'acov, Israel

A trip north took the Fellow to another moshav community at Sde Ya'acov.

Here Ilan Cohen showed his pomegranate groves. He had several groves of various ages, different varieties and using different growing methods.

Single trunk with lateral branches in a vase shape but without trellis was the main feature of this farm. Irrigation consisted of two dripper lines, one each side of the tree. Some groves had plastic ground sheet cover over the irrigation lines to reduce evaporation and reduce weed growth.

"Mature Pomegranate Plants at Cohen Farm, plus Owl Bird House – Owls are used to keep mice under control".

This pomegranate grove had been a research site for Netafim irrigation consultants to develop their new irrigation concepts for pomegranate groves and to monitor the outcomes. The results from this study resulted in an increase in crops from 25 to 45 tonnes per hectare and fruit size to 450 grams per fruit, with a brighter colour from plant population of 357 trees per hectare.

Older plantings, which had wide row spacings, had been inter-planted.

Cohen showed how he had successfully achieved changing older varieties by grafting across to newer varieties.

He also had trial plots of newer varieties that were early ripening fruit and were a part of the Volcani Institute tree development program. These trees had been shaped to single trunk supporting several arms in a vase shape and without trellis systems. They were also irrigated via two dripper lines, one each side of the tree.

6. The International Experience

"The Fellow inspecting a successfully grafted Pomegranate tree – previously considered to be impossible".

Destination 8: Dr Doran Holland, Volcani Research Centre, Newe Ya'ar, Israel

A meeting with Dr Doran Holland, a researcher at the Volcani Research Centre in Newe Ya'ar, was held.

Discussion centred on research into improved varieties and identifying the genetics of the quality characteristic of premium quality varieties. Propagation methods of new planting material were also discussed.

Dr Holland holds several patents for pomegranate varieties, which show self-pollination, medium sized trees with vigorous growth, good fruit productivity and large sized excellent coloured fruit. He has proudly named them EMEK, ACCO and SHANI-YONAY. These varieties had been seen growing at the newer plantings of Cohen's farm.

By this time the Fellow was overwhelmed with information, digesting the adaptations of the various farming systems. Through all this research one overwhelming fact stood out clearly:

Everybody was attempting to produce premium export quality fruit – that is where the money is to be made!

"Fellow discussing advantages of various fruit varieties with Dr Doran Holland".

Conclusion – General Findings and Observations

While different farming practices have been applied in the growing of pomegranates, in particular with or without trellis systems, each approach was working towards the same outcome - to produce high quality unblemished fruit in commercial quantities.

Irrigation systems all included dripper lines, with the only variance either two lines or one line per row. In planning a grove, consideration should be given to soil structure, irrigation equipment and water availability. An irrigation design team should be able to advise on appropriate systems for a particular grove.

Pomegranate varieties

Based on the research by G M Levin between1964-1999 in the region now called Turkmenistan (where he ACTUALLY amassed a collection of 1,117 varieties at a research station), it was identified by the International Genetic Resources Institute (IPGRI) in 2001 that more than 500 pomegranate varieties are known commercially around the world, but only 50 are commonly grown.

These varieties have a range of qualities:

- Very sweet to very acidic
- Soft to medium to hard seeds
- Bright red to white arils
- The market determines the highest appeal.

Currently, planting a variety appears to be a balance of sugar to acid, with soft seeds, a bright red colour and medium to large size.

The varieties being planted in Australia at the moment are:

- Wonderful
- Gulosha Rosavaya
- Gulosha Azerbaijani
- Griffith.

Showroom at the Juran Industries processing plant – display highlighting wide variety of available products.

Thinning and tree structure

Research during the Fellow's study trip highlighted the amount of experimentation being undertaken. It was common that the tree structure was mono-trunk. The vase open centred shape of the tree was a common feature for free standing tree plantations. However, trellis tree systems were incorporated in many groves in Israel.

Harvest

Hand harvesting using snippers to cut the fruit free and careful handling of fruit during post-harvest storage was critical, unless the fruit was for juice production only.

Storage

Post-harvest storage had to be chosen according to the time frame between harvest and processing of the fruit. Short-term storage would require a shed for protection from weather effects on the fruit.

Longer-term storage periods would require cold storage facilities, using modified atmosphere and relative humidity control or Step Pac Storage bags to create modified storage conditions.

Processing

Processing is determined by quality and quantity of fruit to be processed, with specific requirements for particular markets. The main markets are:

- Whole fruit
- Aril extracted packaged fruit
- Juice concentrate
- Juice drinks.

Marketing

Quality and variety of fruit available will determine where the fruit will end up.

Range of pomegranate products

Products the Fellow encountered, taste experienced, or was told about during the Fellowship travel are as follows:

- Whole fruits of premium quality and high dollar value return
- Aril extraction packaged in ready to used quantities
- Fresh or frozen juice
- Wine
- Port wine
- Infused vodka
- Vinegar
- Concentrate (Juice)
- Seed oil
- Jam
- Skin for dyes
- Sauce
- Syrup like balsamic vinegar
- Flowers dried for tea infusion
- Whole fruit crushed dried and powdered for tea
- Nutriceutical products
- Nanotechnology production
- Cosmetic and skin care products
- Hair products
- In candy nut mix i.e. Turkish delight
- Seeds dried crushed added to muesli or bread making.

7. Knowledge Transfer: Applying the Outcomes

The Fellow Robert Jamieson would welcome any enquiry from those interested in the development of this Pomegranate growing activity. Enquiries can be made though ISS Institute and will be passed in to Robert Jamieson for his attention. Please contact ISS Institute on 03 9347 4583 or email to info@issinstitute.org.au.

The Fellow intends to conduct workshops for interested farmers to allow them to experience pomegranate production first hand on the farm where the trial plantings have been established. He will make himself available for conducting information sessions in conjunction with associated agricultural bodies.

The Fellow is currently producing an e-book manual for Pomegranate Farming Best Practice and will also be willing to share his knowledge via any acceptable method that should present itself to promote a pomegranate industry in Australia.

8. Recommendations

Government

Agricultural support is necessary to establish an industry body for pomegranate production and marketing. This should be along similar lines as the recent olive industry development and other new crop industry developments.

Industry

The establishment of a Pomegranate Industry Body will be important for the development and promotion of the product. A network of growers, processors, marketers all need to connect and share knowledge on promotion of the fruit and the growth of the industry.

Education

Health driven promotion of this fruit has already been successfully developed in the USA. There is a need to study their work and develop a planned approach to educate the public of the value of consuming this fruit and the many uses of this fruit needs to be communicated.

Community

Farm open days will provide an opportunity for the public and media programs to experience the pomegranate story. Tasting events are to be encouraged as a way of promoting the juice and fruit and allowing the public to engage in this product.

Health promotion

Pomegranate juice has the status of the new health drink. Supported by recent medical and scientific research it requires more promotion by commercial promoters of the juice. The American success story has been POM brand that has developed and promoted their juice as a healthy alternative drink

CONCLUSION

Concluding Comment – Based on the information gained during the planning for this Fellowship travel, and again supported during the actual research and discussions with a number of experienced international growers, the Fellow is convinced the following question is critical before entering the Pomegranate fruit market.

Anybody considering entering into Pomegranate Grove production on a commercial basis must address this question in some detail, prior to making such an investment.

Do you begin planting now, knowing you have five years for such a new industry to mature, the infrastructure of storage and processing to develop, and the production volume of fruit will increase to create a viable pomegranate industry …

(i.e. take a calculated risk and become an agricultural pioneer)?

… OR …

Do you wait until a promising pomegranate industry has emerged …

(i.e. adopt a conservative follower approach)?

9. References

Adams, L.S, Seeram (2006), Pomegranate Juice, Total pomegranate ellagitannin and punicalagin suppress inflammatory cell signalling in colon cancer cells, Journal of Agricultural and Food Chemistry, 54, 980-985

Al-Zoreky N.S. (2009), Antimicrobal activity of Pomegranate fruit peels, International Journal of Food Engineering ,90, 129-134

Arjmand, A (2011), Antioxidant activity of Pomegranate (PhD Thesis), RMIT University Melbourne

Aviram,M (2002), Pomegranate juice as a major source for polyphenolic flavonoids and its most potent antioxidant against LDL oxidation and atherosclerosis, Free Radical Research, 36, 71-72

Aviram, M & Dornfeld, L (2001), Pomegranate juice consumption inhibits serum angiotensin converting enzyme activity and reduces systolic blood pressure, Atherosclerosis 158, 195-198

Blumenfeld, A. etal (2008), Cultivation of Pomegranates, Institute Agriculture, Volcani Centre, Bet Dagan, Israel

Burt, J & Perth, S (2007), Growing Pomegranates in Western Australia, Depart Agriculture and Food, WA www.agric.wa.gov.au

Day, R.D. (2010), Sample costs to establish and produce Pomegranates in the San Joaquin Valley USA, University of California Co-Op Extension

Eccles, J (2009), A Research & Development strategy for the Australian Pomegranate Industry, RIRDC 09/165

Forest, C.P. (2007), Efficacy and safety of pomegranate juice on improvement of erectile dysfunction in male patients with mild to moderate erectile dysfunction: a randomized, placebo-controlled double blind, cross over study, International Journal of Impotence Research 19, 564-567

Holland, D & Bar-Yaakov (2008), The Pomegranate: new interest in an ancient fruit, Chronica Horticulture. 48, 12-15

Johnson, J.F. (2002), Pomegranate growing, NSW Department of Primary Industry www.agri.nsw.gov.au

9. References

Kader, A.A (1984), Response of pomegranate to ethylene treatment and storage temperature, California Agriculture 38, 14-15

Levin, G.M. (2006), Pomegranate, ISBN 1-932657-73-9

Levin, G.M. (2006) Pomegranate Roads: A soviet botanist's exile from Eden

Lewis, H. (2007), Commercialising Pomegranates in Australia, DAFF New Industries Development Program

Lye, C. (2008), Pomegranate: Preliminary assessment of the potential for an Australian Industry, RIRDC 08/153

Pantuck et al (2006), Phase 2 study of pomegranate juice for men with rising prostate specific antigen following surgery or radiation for prostate cancer, Clinical Cancer Research, 12, 4018-4026

Portman, T. & Johnston, L. (2008), Pomegranates new wheat belt opportunities, Department Agriculture and Food. WA www.agric.wa.gov.au

Seeram, N.P. et al (2007), Pomegranate ellagitannin derived metabolites inhibit prostate cancer growth and localize to the mouse prostate gland, Journal Agriculture and Food Chemistry, 55. 7732-7737

Sheikh, M.K (2006), The Pomegranate, ISBN 81-8189-110-4

Stover, E (2007), The Pomegranate: A new look at the fruit of Paradise, Hort Science Vol 42(5) August 2007

Sumner, M.D. et al (2005), Effects of pomegranate juice consumption on myocardial perfusion in patients with coronary heart disease, The American Journal of Cardiology. 96,810-814

10. Appendices

Appendix 1.

TABLE NAPKIN SUMMARY FOR GROWING POMEGRANATES

Allocate suitable land, (Mediterranean Climate Ideal)

- Wet cold winter and hot dry summer region
- Frost-free area
- Salt free land
- Access to reliable quality and quantity of irrigation water

Soil type

- Will grow in most soils but avoid areas subject to water-logging
- Soil nutrient testing undertaken
- Soil major elements corrected
- Trace elements and micro-nutrients added to tree line beds or via dripper line injection system

Grove design

- Five metre by three metre tree lines running east-west
- Deep rip the tree line
- Raised planting beds

Irrigation

- Dripper irrigation lines, one each side of tree
- Have irrigation system professionally designed
- Ensure access to good water storage for the summer months

Planting stock

- Currently several commercial nurseries in Australia
- 'Wonderful' variety currently available in Australia and the best variety –
- (in the Fellow's opinion after the experience gained during this research)

Marketing

- Small grove sizes say four hectares
- Gives 20 tonnes per hectare
- Say 80 tonne at 60 per cent Grade A top quality would give 48 tonne 'whole fruit' quality

Aril fruit packaged on-site, if processor available

Remaining fruit available for juice market, both fresh and frozen

Post-harvest cool room storage required:

» 7.2-7.5 Celsius in stepac bags left open two days, then sealed (will give three months storage without loss of quality).

Farmer's market option

(Season Four months from May-August, or advanced storage 7 months)

» Sell whole fruit $A3 each (say 500 gram each) equating to $A6,000 per tonne
» Juicer machine $A4,000 for a small mechanical unit to purchase
» Juice sells at $A4 per glass (40-50% juice extraction rate)
» Juice frozen $A10 per litre
» Arils extracted, vacuum sealed and sold by weight
» Frozen juice all year round
» Seed oil production from post juice extraction process
» Fruit skins potential market for pharmaceutical health beauty products

Wholesale market option

» Establish a relationship with fruit wholesale agent
» Direct relationship to retail fruit shops or local supermarkets
» Direct relationship with Juice bars or cafes for whole fruits or frozen juice.

Concluding Comment: This is just an overview or 'table napkin' summary.

To undertake a detailed study the Fellow recommends using the document RIRDC 07/147 – Fresh Fields Strategic and Business Planning Work Book. This will allow for an in depth study into the possibility of a Pomegranate Grove being developed to meet specific requirements.

Appendix 2.

RECOMMENDED CHECKLIST FOR DEVELOPMENT OF A GROVE

Based on his research, visits to overseas working Pomegranate farms, and discussions with overseas experts and experienced farmers, the following checklist was compiled by the Fellow to develop a four-hectare pomegranate grove:

- Chose a site with Mediterranean climate zone, where cold wet winters and hot dry summers are the climatic norms, frost free, no salt affected land and no water-logged land
- Ensure irrigation water supply available for summer months
- Conduct soil nutrient analysis and correct macro nutrients deficiencies
- Pre order pomegranate trees from accredited nursery
- Engage land surveyor to design grove layout, access roads and infrastructure
- Design for five by three metre plant spacing with east west rows if possible
- Engage irrigation designer to plan system
- Good land preparation and raised beds constructed
- Install all subsurface irrigation system
- Plan spring planting post frost risk time
- Water in each tree soon after planting from water cart if dripper lines not installed
- Stake and tree guards provided for each plant
- Install dripper lines if not completed and flush lines
- Install moisture sensors to monitor irrigation requirements
- Install fertilizer injection system into irrigation system
- Prepare and plant mid row with native grass or summer dormant pasture grass
- Mulch around plants prior to summer heat period
- Design fertilizer program, combine foliar and dripper line applications
- Fertilizer application during spring & summer growth stages to promote strong vegetation growth in early years
- Commence trellis system installation as time permits (you have three years before required) if investing in this system rather than free-standing trees
- Slash mid row pre summer if required
- When trees drop leaves and dormant commence pruning and tree shaping
- By second year may have good propagation material for new plantings from pruning work if expanding grove size
- Your 4 ha grove will have 2640 trees (660 trees/ha) when fully planted will at best take one month full time work for a single person to prune and shape plus downtime for wet days
- Careful planning is required when estimating work requirements as indicated above
- Harvest time once trees are in mature production stage around year 5 to 7 is a large labour cost. The fruit has to be hand harvested, clipped off the tree and carefully handling into and out of harvest bins will necessitate good design of harvest bags, bins and bin trailer height

- Forward planning for storage and packing shed to handle up to 80 tonne of fruit
- Access to cool room storage to prolong shelf life of fruit
- Transport access to processing plant.

Depending on availability of skilled labour and the amount of time available of the farmer to apply to the development of the grove it might be more feasible to roll out the development and start with a smaller planting area and expand each year.

Appendix 3.

RECENT SITUATION ON SPECIFIC POMEGRANTATE GROVES

"Mysterious disease wiping out pomegranate groves in various regions of Australia" - (ABC-Rural, April 2013).

The situation is that the tree defoliates and immature fruit still hanging on the tree does not mature. This has devastated several large pomegranate groves in Central New South Wales, North-eastern Victoria, and in the Sunraysia region of Victoria.

Several of these groves have already been cleared of trees.

Barbara Hall (Horticulture Pathologist) from the South Australian Research and Development Institute has urged funding be provided to enable research into this mystery disease can be undertaken.

At this time this disease has not been identified and no significant research has as yet been undertaken.

A prudent approach may well mean balancing the possible gains to be made by becoming a 'leader in the field' and developing a plantation or crop as soon as possible, against following a 'fast follower' strategy - by waiting until more is known about this current disease affecting many existing pomegranate crops.