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The enhancement of citrus value chains production in Pakistan and Australia through improved orchard management practices

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The HORT/2010/002 project team would welcome further opportunities to work within Pakistan. The team has considerable experience and has established strong networks with government and industry in Pakistan.

2 Executive summary

This final report outlines the achievements of HORT/2010/002 which aimed to improve management practices in Pakistan to maximise fruit production and returns in citrus growing regions of Punjab and KP. The project received four years of funding from Australian Aid program and the project was managed by ACIAR.

The Pakistani citrus industry is dominated by production of Kinnow mandarin and blood orange. Due to prevailing knowledge, plantings and cultural practices; yields are low and the citrus marketing season is short. The introduction of new and appropriate citrus scion and rootstock varieties and adoption of modern practices in Pakistan will increase yields and extend the harvest and marketing season. Increased production and an extended production window will provide more income for growers, nurserymen and women, and more opportunities will be made available to the poor and marginalised workers who work as labourers in citrus orchards during the harvest and pruning seasons.

This project had scientific, economic and social objectives, described below. The fourth objective was added in the final year.

Specific objectives were:

1. To introduce citrus germplasm to Pakistan and develop germplasm evaluation capacity amongst research and extension staff, to extend the marketing season and assist in improving nursery production practices for maintaining and multiplying healthy 'clean' material.
2. To improve basic crop management practices and to examine current irrigation practices, assessing the feasibility of pressurised irrigation systems for citrus growers.
3. To enhance citrus crop management research, extension and production capacity of Pakistan citrus institutes and industry, extending 'pro-poor' benefit flows.
4. To carry out a scoping study in Pakistan and in Kinnow exporting countries for further enhancement of industry opportunities through the development of a citrus supply chain project (2016-2020).

This project successfully achieved all four objectives during its four year duration. Additional work not originally planned within the project scope resulted in significant benefits to citrus growers. This included the establishment of four quality payment sites to enable direct fruit marketing by growers, increasing grower profits and opportunities. The project also linked with the women's NGO Pakistan Hoslamand Khawateen Network (PHKN) to empower Pakistani women through nursery management training which provided new business opportunities.

Key project achievements are outlined below.

- Seven new citrus scion varieties and eight new citrus rootstocks were introduced to Pakistan. When trees of these scion varieties reach productive age, the citrus harvest and marketing period will be expanded by at least 6 months. The new rootstocks will improve the productivity of scion varieties and enable different varieties to be grown on different soil types.
- Three insect-proof screenhouses were built at the research institutes in Pakistan to conserve citrus germplasm and supply healthy propagation material and trees for research trials and for the establishment of budwood supply 'mother' blocks.
- Eight mother blocks were established at research institutes in Pakistan to conserve citrus germplasm and provide a source of healthy propagation material for industry.

- The project trained 494 Pakistani nursery workers (men and women) and growers in improved nursery management practices and provided them with the equipment to produce healthy, grafted citrus trees. The adoption of low cost practices, such as chip budding to increase bud take, has resulted in improvements to tree quality and allowed nurseries to increase the sale price of their trees. Growers are willing to pay more for a healthy tree that has a greater chance of survival when transplanted in the field. Four screen houses have been constructed by commercial nurserymen in Punjab and KP after they received training through the project to improve the growing environment and product quality. Trainees have assisted with extension activities to disseminate the knowledge to a wider audience.
- Research and extension staff, citrus growers and nurserymen/women were trained in modern orchard management practices. The concept of timing management practices like fertiliser application, pruning and fruit thinning according to phenological growth stages rather than calendar dates was introduced and adopted by growers in both growing regions, with the assistance of a phenological chart developed for Pakistan by project team members. Adoption resulted in an increase in the amount of first grade fruit produced which resulted in an increased income for marginalised growers. During the course of the project, 470 growers were trained in canopy management techniques (pruning and reworking). Pruning has now been adopted by 20% of the citrus growers in the Punjab as they can see the subsequent benefits to tree health and crop yield. The project trained 107 growers in fruit thinning which was not practiced in Pakistan prior to the start of this project. It is estimated that 15 % of citrus growers are now using fruit thinning to manage crop load.
- Modern citrus orchards in Australia use pressurised irrigation systems. During the project it was decided that pressurised irrigation systems were not yet a practical option for Pakistani growers, so furrow irrigation was promoted as an alternative to the traditional flood method widely used within the country. During the project, 604 growers received training in furrow irrigation systems and 200 one acre citrus properties in KP have adopted furrow irrigation. As a knowledge transfer spill over, the method has also been adopted by 400 apricot and peach growers in KP.
- Nursery women were trained in modern nursery management practices and provided with nursery equipment to prepare clean trees. These women participated in the project as part of a link made with the PHKN which translates as the 'Pakistan Courageous Women Network'. The nursery women have increased their profit margin by 50% as a result of adopting new practices learnt through the training and using equipment provided by the project. The trainees have also started to educate other nurserywomen in their region.
- The capability of Pakistani research and extension staff and industry members was enhanced through knowledge transfer and upskilling within this project. Nine postgraduate students completed their degrees within the project, with one student awarded a John Alwright Fellowship (JAF) for study at Curtin University in Perth, Australia. Over the course of the four year project, the Australian team travelled to Pakistan 11 times to deliver training and Pakistan project team members, extension officers, nursery men and women, growers, and students made 6 visits to Australia. A total of 55 Pakistanis received individual training in nursery, crop and irrigation management in Australia. The project generated 11 research papers which were presented at the International Horticultural Congress in Brisbane in 2014, and 2 papers were presented at the International Citrus Congress in Spain in 2012.
- Information on best practice management was extended to government and industry in Pakistan via 12 citrus manuals, 9 newsletters, 43 fortnightly e-

newsletters to 399 growers, 42 SMS messages to 1150 growers, 36 radio talks and 27 TV programs.

- Eight training packages were produced on nursery management, irrigation management and crop management during the project life and were launched in September 2015 at NARC. The training packages were made available at the NARC Web site.

The project has established strong linkages National Agriculture Research Centre (NARC), Agriculture Research Institute (ARI), Peshawar (KP), Citrus Research Institute, Sargodha (Punjab), University of Agriculture, Faisalabad (UAF), Fruit and Vegetable Development Project (FDVP), UNIDO, KP Flood Rehabilitation program, commercial nurseries in KP and Punjab, Australia-Pakistan Agricultural Sector Linkages Program (ASLP) social and mango production projects, Agriculture Training Institute Sargodha, and the Agribusiness support fund, Lahore. Outside of Pakistan, links have been formed with Maejo University, Chiang Mai and Thanathon Orchards, Fang Thailand. Both venues were used for nursery and crop management training. Links were also established with South China University, Chongqing, People's Republic of China.

A scoping study to satisfy the fourth project objective was conducted in January 2015, prompted by recommendations from the mid-term project review and using additional funds from Australian Aid. The objective of this study was to identify issues and opportunities in the post-harvest supply chain in Pakistan. During the scoping study citrus industry forums were conducted in Pakistan and attended by growers, packers, exporters, marketers, wholesalers, retailers and consumers. Visits were also made to wholesale, retail and supermarkets in two major 'Kinnow' importing countries; Indonesia and Dubai. Meetings were held with importers to discuss import and marketing issues and opportunities for Kinnow fruit. It was found that Kinnow fruit competed well against Ponkan mandarin from China and Clemeville mandarin from Spain. Kinnow fruit was well presented in supermarkets and was cheaper to buy than other citrus.

To continue the momentum towards change within the Pakistani citrus industry, it is recommended to include citrus postharvest and export marketing work in Agriculture Value Chain Collaborative Research (AVCCR) in a proposed future project (2016-2020). An AVCCR scoping study conducted in August 2013 and funded by Australian Aid strongly recommended the continuation of citrus value chain work in Pakistan, ranking citrus as the third priority commodity for future work.

3 Background

This final report covers four years of work funded by Australian Aid and managed by ACIAR to enhance citrus value chain production in Pakistan and Australia through improved orchard management practices.

3.1 Pakistani Citrus Industry

Pakistan's economy has undergone considerable diversification over the years, yet agriculture remains the largest sector of the economy. This sector contributes 13% to Gross Domestic Product (GDP) and employs 42% of the total labour force. Nearly 68% of the country's population living in rural areas are directly or indirectly dependent on agriculture for their livelihood. In the horticulture sector, citrus ranks as the most important commercial crop followed by mangoes, bananas, apples and grapes. Approximately 29.5% of the total fruit producing land is occupied by citrus of which 95% is produced in the Punjab, 1.6% in the Sindh and 2.2% in the Khyber Pakhtunkhwa (KP) (formerly known as NWFP Province). Of the total citrus production, approximately 10% is exported, 2% is processed, 30-40% is lost due to postharvest disorders and damage, and the rest is sold locally in Pakistan. Table 1 shows production statistics for Pakistan citrus 2008-2013 (FAO STAT 2015).

Table 1. Citrus Statistics 2008-2013 (Area harvested, Yield and Production) (FAO STAT 2015)

	2008	2009	2010	2011	2012	2013
Area harvested (ha)	139,580	139,958	138,880	136,150	136,000	136,800
Yield (t/ha)	11.5	10.6	10.8	10.2	10.4	11.0
Production (tonnes)	1,606150	1,492400	1,505000	1,387540	1,503140	1,505000

Citrus production is dominated by Kinnow; Pakistan is the sixth largest producer of Kinnow in the world and more than 90% of its citrus exports are Kinnow. A study carried out at the University of Faisalabad (Ahmad and Mustafa, 2006) predicted export of Kinnow mandarin to be 2279000 tons in 2015 and 2617000 tons in 2022. While Kinnow mandarin remains the major citrus type, mainly produced in Punjab region, oranges (blood oranges and Valencia) are produced in KP province. The total area under orange production in KP has expanded in recent years to 5,500 ha with a total production of 40,000 tonnes (Shah, 2004), all consumed locally. Development of the orange industry in KP will be enhanced by the introduction of new citrus varieties and the implementation of 'Best Practice' production technology for the growing of consistent, high quality fruit for the export market (Anwar and Ibrahim, 2004). It is recommended that the Pakistan citrus industry seriously considers promoting blood oranges and blood orange juice for export.

The population of Pakistan in 2015 is 188 million (with an annual growth rate of around 2%) which offers a strong market for domestic citrus consumption. Citrus is also an important export crop for foreign earnings. Pakistan currently exports citrus to Russia and UAE (the biggest buyers this season who imported over 31,000 tonnes), the Philippines (16,795 tonnes), Iran (18,737 tonnes) and Saudi Arabia (11,792 tonnes).

Pakistani exporters are exploring potential new overseas markets. Using the competitive advantages of strategic location (in relation to target markets), competitive prices and development of Kinnow as a national identity (i.e. brand awareness); the Pakistan Horticulture Development Export Company (PHDEC) is developing markets in Eastern Europe (Czech Republic and Poland) and Germany. Market access has been granted by

China but export has not yet commenced. The Vietnamese market, though currently small, is believed to have growth potential. The PHDEC is investing in market development and the Pakistan Government is investing (in conjunction with other donor agencies) in infrastructure (such as roads and storage facilities). The PHDEC acknowledges that the ambitious export targets set by the Government can only be sustained in the longer term with the introduction of new citrus varieties (rather than reliance on Kinnow alone), supply chain reforms and increases in farm productivity, efficiency and fruit quality which are only possible if key production constraints are addressed.

3.2 Australian Citrus Industry

Citrus is one of the largest and most important horticultural export commodities in Australia, producing around 600 thousand tonnes annually, although on the world scale this represents less than 1% of production (Citrus Australia Ltd pers. comm.). The major citrus varieties grown are navel oranges (39%), Valencia and common oranges (30%), mandarins and mandarin hybrids (24%); lemons and limes (6%); and grapefruit, citron and pummelo (1%) (Hancock 2015). Worldwide, there is increasing demand for mandarins due to their perceived quality and convenience (size, ease of peeling, sweetness). The majority of new citrus cultivars introduced into Australia in recent years were seedless mandarin selections. The Australian industry (Chown, 2006) is of the view that considerable potential exists in both the domestic and export markets for Australian mandarins. Industry supports a national breeding program to develop new mandarin cultivars and create new market opportunities.

However, to date most of the production research undertaken in Australia has focused on oranges, as they represent the largest industry sector. Mandarins require different and often a higher level of tree management than what is needed for orange varieties. Practices which enhance early production and improve cropping potential, fruit quality and size need to be identified for Australian conditions. In Australia, the application of growth regulators and nutrition is encouraged to align with phenological stages rather than calendar dates (Khurshid, 2004); although there is no detailed phenological data available for oranges or mandarins to assess flower timings, cell division/enlargement stages, fruit growth rates and maturity. *HORT/2010/002* presented an opportunity for crop phenology data collection in Australia and Pakistan.

3.3 Evolution of HORT/2010/002

In July 2006, industry constraints and R & D priorities for the Pakistan citrus industry were analysed as an ASLP activity (Khurshid and Baxter, 2006). The scoping study and workshop focussed on the 'Kinnow' mandarin industry in Punjab, and the orange industry in KP, identifying issues that could be addressed through subsequent activities funded by ASLP. Based on findings from the scoping study, a citrus project was developed and conducted in Phase 1 of ASLP.

A review of the ASLP Phase 1 citrus project conducted in November 2008 revealed that there remained considerable potential to increase individual tree yields, increase fruit quality and reduce postharvest losses in Pakistan. Minimal R&D information was reaching the growers due to the flawed structure of the extension services and poor communication between extension service providers. A lack of extension staff trained in best practice management for citrus further exacerbated production constraints.

The key constraints faced by the Pakistan citrus industry as identified by the PHDEC were the narrow season of production, reliance on one cultivar, poor orchard and nursery practices, unreliable supply of healthy certified rootstock seed and scion budwood, inefficient fruit production and irrigation practices, lack of cultivar and rootstock choice, non-availability of a seedless cultivar, over production in an "on-flowering" year followed

by a poor production by an “off-flowering” year, post-harvest losses, lack of cold storage facilities, dysfunctional research and extension system, small scale farming, the pre-harvest contract system (advance sale to middle men) which has a strong influence on the growers ability to adjust crop load or prune trees), and disadvantaged growers with lack of knowledge, literacy and access to information.

The citrus commodity project of ASLP Phase 2 (HORT/2010/002) was developed by Pakistan and Australian project team members in collaboration with Australian Aid, the Pakistan Agriculture Research Council (PARC), the Ministry of Food, Agriculture and Livestock (MINFAL) and representatives from the Pakistan citrus industry. It was decided that the citrus component would include the introduction and evaluation of new varieties and rootstocks to extend the season of production, and the introduction of improved nursery and orchard management techniques for the sustainable and efficient production of high quality fruit. The citrus commodity team would also aim to strengthen the capability of citrus researchers, extension workers and industry practitioners and strengthen the flow of benefits to the poor and marginalised - through the training of Farmer Field School facilitators, and the training of research and extension personnel (train the trainer).

The citrus project in ASLP Phase 2 (HORT/2010/002) focussed on in-field practices rather than postharvest issues. However, a supply chain scoping study was carried out in Pakistan and two citrus exporting countries (Dubai and Indonesia) towards the end of this project at the request of AustralianAid who provided additional funds. The scoping study focussed on pre-harvest issues leading to postharvest problems along the supply chain in both domestic and export markets.

The objectives for the citrus commodity project of ASLP Phase 2 were:

1. To introduce germplasm to extend the marketing season and assist in improving nursery production practices for maintaining and multiplying clean material.
2. To improve basic crop management practices, examine the current irrigation practices and assess the adaptability of pressurised irrigation systems.
3. To enhance the research, extension and production capability of Pakistan citrus institutes and industry.
4. To carry out a scoping study in Pakistan and other Kinnow exporting countries for the development of a citrus supply chain project (2015-2020).

3.4 Australian component

3.4.1 Evaluation of superior Chinese rootstocks for mandarin and orange (Navel and Valencia) in different climatic and soil conditions in Australia

In a previous ACIAR project (and then in a Horticulture Australia Ltd (HAL) funded project) rootstock varieties were identified with potential for use under orange and mandarin scion varieties due to their positive influence on yield and fruit quality in a field trial under the deep sandy soil conditions at Dareton, NSW Australia. The project also identified salt tolerant rootstocks, which were tested in a field trial at Bindoon, Western Australia (WA) where salts can be a production constraint. Rootstocks are currently being tested on grower properties in trials funded by Horticulture Innovation Australia Limited (HIA).

3.4.2 Collection of phenology information for blood orange at Dareton

Data was collected for a number of commercially grown blood orange varieties with different maturity times and linked to climate studies on anthocyanin (red colour) development in fruit.

Climate studies also analysed changes in the timing of citrus flowering in citrus over time. At Dareton Primary Industries Institute in the Sunraysia, the time of full bloom has advanced by 10-14 days over the last 12 years. Intense heat in November 2009 resulted in sun burn of fruit and exposed leaves, an event which had not before been recorded. This information prompted citrus growers to develop strategies to avoid crop loss in preparation for extreme heat events during spring.

3.4.3 Scanning electron microscopy (SEM) to identify the flower initiation and differentiation stages in sweet orange under local conditions

Plant growth regulators (PGRs) like gibberellic acid (GA3) or GA3 formulation (Ralex®) can be used to control flowering in sweet orange in an expected on-year if applied at the floral initiation stage (Khurshid, 2005). Timings of flower initiation reported by Lord and Eckard (1985, 1987) from the University of California were extrapolated by growers in the Sunraysia/Riverland/Riverina districts as the timings in these regions were not known. This study helped quantify the timings of flower initiation and differentiation in the Sunraysia to assist growers with timing applications of plant growth regulators (PGRs) to manage crop load.

4 Objectives

HORT/2010/002 had four main objectives all aimed at the enhancement of citrus value chain production in Pakistan and Australia through improved orchard management practices. These were:

1. Introduction of germplasm to extend the marketing season and assist in improving nursery production practices for maintaining and multiplying clean material.
2. Improve basic crop management practices, examine the current irrigation practices and assess the adaptability of pressurised irrigation systems.
3. To enhance the citrus crop management research, extension and production capacity of Pakistan citrus institutions and industry.
4. To carry out a scoping study in Pakistan and Kinnow exporting countries for the development of a citrus supply chain project (2016-2020).

4.1 Introduction of germplasm to extend the marketing season and assist in improving nursery production practices for maintaining and multiplying of clean material.

This objective aimed to overcome the following problems within the Pakistan citrus industry:

- **Reliance on one major variety:** Kinnow is a late maturing mandarin variety which is the main citrus cultivar produced in Pakistan (mainly in Punjab province). Punjab produces more than 90% of the total citrus production in Pakistan. Blood oranges are produced in KP but tree yields are low and fruit are normally consumed locally.
- **Short marketing season:** Due to the limited number of citrus cultivars the growing season is very short and packing houses also operate for a limited period of time. An extended harvest window will create more job opportunities in orchards during harvest and pruning seasons.
- **Reliance on a limited number of rootstocks:** The only rootstock used in Punjab is rough lemon (*Citrus jambhiri*) and in KP is sour orange (*Citrus aurantium*). Rough lemon is highly susceptible to *Phytophthora* collar rot, citrus nematode and water logging. It also accumulates chloride, leading to leaf drop. Sour orange is susceptible to *Phytophthora* and to strains of *Citrus tristeza virus* that induce quick decline in sweet orange and mandarin on sour orange rootstocks.
- **Poor nursery trees for orchard establishment:** Traditional nursery production techniques in Pakistan are commonplace and there is a poor understanding of nursery hygiene, nutrition, irrigation and management of pests and diseases. Consequently, unhealthy nursery trees are often used to establish citrus orchards with a low rate of survival after transplanting and those that do survive are often not productive.
- **Lack of houses for production of healthy material:** There are a number of citrus diseases for which there is no cure. Management of these diseases involves propagating trees using disease-free (clean) buds and rootstock seedlings. Some diseases are also transmitted by insect vectors therefore clean material should be propagated in insect

proof screenhouses which operate under strict hygiene protocols. Prior to the citrus project, no insect proof screenhouses existed in any commercial citrus nursery in Pakistan, nor at any citrus institute in Pakistan.

4.2 Improve basic crop management practices, examine the current irrigation practices and assess the adaptability of pressurised irrigation systems.

This objective aimed to overcome the following problems within the Pakistan citrus industry:

- **Lack of understanding of crop phenology:** In Pakistan, the timing of management practices were determined by a calendar date and not according to the phenological stage (growth phase) of the tree. The phenological stages of different citrus cultivars vary, and therefore the application of crop management practices needs to be adapted to the citrus variety, climate and season.
- **Poor crop management (pruning and fruit thinning):** Crop management by pruning and thinning is vital to enhance yield and fruit quality. In Pakistan, there is a poor understanding of the concept of pruning and fruit thinning was not practiced prior to the project. Kinnow mandarin needs fruit thinning to enhance fruit size and alleviate biennial bearing. Good nutrition management is also lacking and it is not common practice to send leaf and soil samples for chemical analyses.
- **Poor irrigation management and rootstocks not suited to soil types:** Flood irrigation is a common practice in Pakistan with water available once a week through a canal system. In winter months, growers use saline ground water for irrigation when canal water is not available. Flood irrigation increases the risk of water logging on the clay loam soils used in citrus growing regions, increasing issues with root rot.
- **Low planting density and production:** In Pakistan, trees are planted at a greater spacing (lower planting density) than in the United States (US) or Australia. Average citrus yield in Pakistan is 14 tonnes/ha compared to Australia where average production figures are 40 tonnes/ha for Washington navel and 60 tonnes/ha for mandarin varieties.

4.3 To enhance the citrus crop management research, extension and production capability of Pakistan citrus institutions and industry.

Knowledge of modern citrus practices was lacking in Pakistan. It was identified that training of research and extension staff, industry service providers, nurserymen and women, growers and students was needed in the following areas:

- nursery management
- canopy management – pruning and crop thinning
- nutrition
- irrigation
- high density plantings

The trainees would then serve as 'trainers' to transfer knowledge and skills to a wider audience, including the poor and marginalised.

4.4 To carry out a scoping study in Pakistan and Kinnow exporting countries for the development of a citrus supply chain project (2015-2020).

Product wastage is a significant issue faced by the Pakistan fruit industry. In citrus crops, 30-40% of fruit is wasted during harvest, transport, packing, and domestic and overseas transit before reaching the consumer. Supply chain analysis will identify the impact of the different stages on fruit loss, allowing strategies to be developed to minimise such loss.

This component of the project aimed to determine opportunities for a future collaborative research program focussed on value chain improvement within the Pakistan citrus industry. The scoping study included reviewing opportunities to partner with private sector participants along particular value chains.

5 Methodology

5.1 Introduction of germplasm to Pakistan

Currently Pakistan is heavily dependent on one mandarin variety called Kinnow and therefore the citrus growing season is very short. Kinnow is very seedy and late maturing with a strong tendency towards biennial bearing. New and early mandarin varieties were sent to Pakistan to extend the growing and marketing seasons. The new varieties will be able to compensate for the poor yields of Kinnow in 'off-years' and provide new market opportunities. Some of the new varieties are also less seedy than Kinnow.

To introduce new germplasm to Pakistan, the project facilitated:

- the export of budwood (7 scion cultivars and 8 rootstocks) to research institutes and commercial nurseries in KP and Punjab;
- the establishment of mother blocks of varieties and rootstocks at NARC, UAF, ARI and CRI;
- the preservation of genetic material in Germplasm units in Punjab and KP;
- training of research staff in varietal evaluation;
- training of commercial nurserymen in nursery management in Pakistan, Thailand and Australia; and
- the establishment of a Chinese rootstock evaluation trial in Perth (WA).

5.2 Development of screenhouses

The Pakistan citrus industry requires a supply of high health status propagation material (budwood and rootstock seed) that can be used to produce healthy nursery trees for orchard establishment. Insect-proof screenhouses were erected at research institutes in Pakistan to enable the propagation and growing of disease-free material. Training was also provided to the Pakistani nurserymen (in Pakistan, Thailand and Australia) to enhance their ability to produce clean trees.

Specifically, the project:

- built screenhouses at the CRI, ARI and NARC research institutes;
- encouraged commercial nurserymen to build screenhouses for commercial production;
- established linkages between Pakistan, Thailand and Australian Nurserymen and Auscitrus to facilitate knowledge and skills transfer; and
- published a comprehensive nursery manual (in collaboration with the ASLP mango production project) and fact sheets.

5.3 Improvement of basic crop management and irrigation practices

The improvement of crop management practices is of vital importance to increase yield and fruit quality in Pakistan citrus orchards. Kinnow is a strongly biennial variety, therefore pruning and thinning is required to produce a sustainable yield every year. Field trials, extension materials and training were delivered to transfer knowledge and skills to industry; project team members actively encouraged and helped growers to adopt improved management practices.

Specifically, the project:

- held a planning meeting at PARC Islamabad with key project personnel to determine the best location for demonstration orchards and to develop the management plan for field trials, this included a schedule of operations and resource needs;
- crop phenology trials were established at CRI for Kinnow mandarin and at ARI for blood oranges; tiny tag data loggers were installed at the experimental sites to collect localised temperature and humidity data;
- quality payment sites were established on commercial grower properties and crop management training was provided to growers;
- pruning trials were established at CRI for Kinnow and ARI for blood oranges to compare different pruning methods;
- flood irrigation systems were modified to furrow systems on suitable commercial properties and pressurised drip irrigation systems were installed in research orchards as demonstration sites; a flume data logger, to record water use in the furrow system, was sent to Pakistan to collect data from furrow irrigation trials;
- demonstration orchards were established at progressive grower's properties in the Punjab and KP to enhance knowledge and skill transfer in pruning techniques, irrigation management and high density plantings;
- research and extension officers were trained in improved management practices including canopy, nutrition and irrigation management and the installation and use of water monitoring equipment (tensiometers); staff at CRI and ARI installed tensiometers in the pressurised irrigation system trial;
- field days were held to provide information on improved management practices including canopy management (pruning and reworking) and furrow irrigation;
- a trial to quantify floral initiation stages of citrus to enhance management of crop load was established on Hockney naval at Dareton NSW; while phenology trial for 10 commercially grown naval cultivars of different maturity was established at Dareton.
- water use efficiency trials were established at Dareton, NSW for 2 mandarin varieties;
- extension materials were developed to aid the transfer of knowledge and skills in improved crop management practices; and
- phenology calendars were developed for Pakistan and printed in two languages (English and Urdu) for distribution to growers.

5.4 Enhance the research, extension and production capacity of project staff and the Pakistan citrus institutes and industry

5.4.1 Capability building

Citrus nursery and orchard management practices must be improved in Pakistan to guarantee industry sustainability and provide reliable income streams for poor and marginalised growers. This can only happen if local representatives are given knowledge and skills to transfer to the greater industry – ‘train the trainer’ approach. In this project, government officers and key industry representatives were given training and developed practical skills for improving nursery and orchard management practices.

In addition to technical training, professional development of Australian and Pakistani scientists and extension staff was achieved through presenting at international conferences; International Citriculture Congress in Spain in 2012 and International Horticultural Congress in Brisbane in 2014.

5.4.2 Training and Extension

Training activities were conducted in Pakistan, Australia and Thailand and took the form of theoretical and practical workshops, study tours and practical work experience.

Pakistanis who attended training outside of Australia, delivered training to Pakistani citrus growers, contractors and field workers upon their return to Pakistan, as part of a participatory extension model. In the Punjab, team members tapped into the existing network provided by the F&VDP to hold Farmer Field Schools.

Training materials were produced by the project team; fact sheets, manuals, newsletters (electronic and printed), text messages, and radio and television broadcasts.

Training was provided in the following subject areas:

- nursery management
- canopy management – pruning
- management of crop load – thinning
- nutrition
- irrigation
- high density plantings
- crop phenology
- fruit quality
- direct marketing
- variety evaluation – rootstock and scion.

5.4.3 Empowering women in the Pakistani nursery industry

Women in Pakistan do not work in citrus orchards (harvesting or pruning) or in packing sheds. It was identified that women do work in the nursery industry propagating a number of horticultural commodities. Therefore it was decided to increase their capability by training them in citrus propagation and nursery management to enhance income streams and business opportunities for this marginalised sector of the Pakistani community. Nurserywomen from KP were identified as key representatives to take the knowledge back to the women in their region and were given advanced citrus nursery training in Pakistan, Thailand and Australia.

5.4.4 Postgraduate training

Nine postgraduate students were linked to the project, included one student who was awarded a John Allwright Fellowship (JAF) to study at Curtin University, WA.

5.5 Scope future supply chain research needs for ‘Kinnow’ exporting countries

This work was a late addition to the project scope based on recommendations from the mid-term project review in April 2013. A citrus value chain scoping study was conducted in Pakistan and in export markets in Dubai and Indonesia and involved:

- citrus industry forums in Pakistan to examine supply chain issues attended by researchers, extension officers, growers, packers, nurserymen/women, exporters, wholesalers, contractors and consumers;
- meetings with Pakistani high officials to brief them on the outcomes of the forums;

- following the supply chain to Dubai and Indonesia to meet with importers, marketers and retailers and visit supermarkets, hyper-markets and wholesale markets;
- producing a scoping study report 'Towards the development of a citrus supply chain project for Pakistan and 'Kinnow' exporting countries (2016-2020)' outlining recommendations for future work.

6 Achievements against activities and Outputs/milestones

Objective 1: To introduce germplasm to extend the marketing season and assist in improving nursery production practices for maintaining and multiplying clean material

No.	Activity	Outputs/milestones	Completion date	Comments/outcomes
1.1	Select potentially superior germplasm (rootstock and scion-budwood) to send to Pakistan (A&P)	<ul style="list-style-type: none"> Detailed plan, resource identification (P) Source rootstock seeds and scion material from Australia to send to Pakistan (P) and mother block established Trial establishment of Chinese rootstock expansion to Perth (WA) and Riverina (NSW) for evaluation and assessment (A) 	<p>Yr1, m11</p> <p>Yr2, m3 to Yr3, m3</p> <p>Yr2, m3 to Yr4, m4</p>	<p>Year 1</p> <ul style="list-style-type: none"> Detailed planning meeting was held in May 2011 at University of Agriculture Faisalabad (UAF) with all collaborators from Pakistan. Dr Tahir Khurshid and Mary Cannard (Murray Valley Citrus Marketing Board) from Australia participated in the meetings and conducted several workshops. Annual planning meeting with project collaborators was held on 21 Feb 2012 at UAF. Participants in addition to Pakistani and Australian project team members included Dr Iftikhar Ahmad, Dr Azeem and Dr Iqrar Khan (VC UAF) and members of the ASLP social project team. Budwood of seven citrus scion cultivars (Cara Cara (red flesh) navel, Seedless McMahon Valencia, Daisy mandarin, Ryan navel, Arnold blood orange, Harvard blood orange and Salustiana orange) was sent from high health status sources in Australia to Pakistan on 3 May 2012 for propagation within research institutes and commercial nurseries. Rootstock seed germinated and seedlings grown for a demonstration trial of selected Chinese rootstocks in WA. <p>Year 2</p> <ul style="list-style-type: none"> Mid-term project reviews were held on 3 April 2013 in Canberra and 20-21 April 2013 in Pakistan. Dr Tahir Khurshid visited Pakistan to participate in the project review. Positive feedback was received from the project review in Canberra and Pakistan. Rootstock seedlings transported to WA on 2 April 2013 and planted at the trial site in Bindoon. Dr Tahir Khurshid inspected the WA trial site on 4 June 2013. Trip outcomes reported in Sept 2013 (Yr3) at the annual review meeting in Canberra. <p>Year 3</p> <ul style="list-style-type: none"> Rootstock trial in Bindoon WA, Data on tree height and trunk diameter collected in Sep 2014. <p>Year 4</p> <ul style="list-style-type: none"> Riverina Trial, Yield data has been collected in Oct 2015.

1.2	Establishment of screenhouse in CRI/ARI/NARC (P) and training in nursery production practices (A)	<ul style="list-style-type: none"> • Detailed plan for Punjab and KP screen house sites (P) • Completion of screen house construction • Training of nursery staff in nursery production procedures (A) • Training of researchers in working with high health status germplasm • Nursery manual and fact sheets completed (A & P) 	<p>Yr1, m11</p> <p>Yr2, m3 to Yr3, m4</p> <p>Yr2, m4</p> <p>Yr3, m9</p>	<p>Year 1</p> <ul style="list-style-type: none"> • Sites identified with consultation for screen house locations. • Screen house construction at CRI completed, structure inaugurated in Jan 2012. <p>Year 2</p> <ul style="list-style-type: none"> • Training in nursery management delivered to nurserymen in KP in January at ARI tarab (Trainers: Ghulam Nabi). • Screen house construction at ARI in KP completed. Minister of Agriculture Arbab Ayub Jan visited the screen house on 3 April 2012. The budwood arrived in May 2012 and was propagated in the new screen house. • Screenhouse construction at NARC completed in April 2012. Budwood of new scion varieties from Australia arrived in May 2012 and was propagated in the new screen house. • Training of nurserymen in Australia – practical work experience in commercial citrus nurseries (Victorian Citrus Farms and Birdwood) in Nov 2012 (Training coordinators Nerida Donovan, Ian Bally). <p>Year 3</p> <ul style="list-style-type: none"> • Nursery management training delivered in October 2013 in Islamabad, Sargodha and Faisalabad to nurserymen and women, citrus growers, government officers and university students (Trainers: Tahir Khurshid, Nerida Donovan, Jason Bowes, Inam-ul-Haq). <p>Year 4</p> <ul style="list-style-type: none"> • Nursery management training held in Thailand, November 2014 for Pakistani nurserymen and women, citrus growers, government officers and university students (15 participants / Trainers were Tahir Khurshid, Nerida Donovan, Jason Bowes). • Training in nursery and crop management during study tour in Australia in April 2015 (19 participants / Training coordinators: Tahir Khurshid & Steven Falivene). • Joint citrus and mango nursery manual (Authors: Nerida Donovan, Ian Bally, Tony Cooke. Editor: Susan House) and citrus fact sheets (Authors: Steven Falivene, Nerida Donovan) were completed and launched in Pakistan in September 2015. The manual will be published as an ACIAR publication. Jeremy Giddings and Tahir Khurshid wrote the fact sheets on Irrigation and rootstocks.
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1.3	Training in evaluation of germplasm, rootstock and scions (A)	<ul style="list-style-type: none"> Identify the suitable potential extension officers for training (A) Training held in Australia/Thailand Pakistan staff implemented training 	<p>Yr1, m11</p> <p>Yr2, m3 & Yr2, m11</p> <p>Yr2, m11 to Yr4, m3</p>	<p>Year 1</p> <p>Two officers identified for nursery, crop and irrigation management training in Australia.</p> <p>Year 2</p> <p>Two project officers Tauseef Tahir (Punjab) and Wajid Ali (KP) received training for two weeks in nursery, crop and irrigation management at Dareton, Australia during August 2012. (Trainers: Tahir Khurshid, Steven Falivene, Graeme Sanderson, Jason Bowes)</p> <p>Year 3</p> <ul style="list-style-type: none"> Training participants identified. <p>Year 4</p> <ul style="list-style-type: none"> Training in advanced nursery management and top-working held in northern Thailand in November 2014 (15 participants / Trainers: Tahir Khurshid, Nerida Donovan, Jason Bowes). Training in nursery and crop management during study tour in Australia in April 2015 (19 participants/ Training coordinators: Tahir Khurshid & Steven Falivene).
1.4	Establishment of phenology data collection for navel cultivars and flower physiology work (A)	<ul style="list-style-type: none"> Detailed phenology data collection program established (A) Trial site identified & data collection(A) Phenology data analysed 	<p>Yr1, m7 to Yr4, m4</p> <p>Yr1, m7</p> <p>Yr3, m7</p>	<p>Year 1</p> <ul style="list-style-type: none"> Replicated trial site established at Dareton. Phenology data collected for 10 commercially grown navel cultivars based on different maturity periods (early maturing, mid maturing, late maturing and very late maturing). <p>Year 2</p> <ul style="list-style-type: none"> Phenology data collected and analysed. Phenology calendars developed for Kinnow mandarin and blood orange in English and Urdu. A3 poster size distributed to growers in Pakistan in February 2013. <p>Year 3 and 4</p> <p>Phenology data collected and analysed.</p>
1.5	Flower initiation and differentiation work using scanning electron microscopy (SEM)	<ul style="list-style-type: none"> Field trials established, Ralex® applied to the trees, bud harvest carried out Buds examined for flower initiation and differentiation stages 	<p>Yr1, m7</p> <p>Yr2, m7</p> <p>Yr1, m3 to Yr4, m8</p>	<p>Year 1</p> <ul style="list-style-type: none"> Buds harvested from the Ralex® trials in August 2010 and sent for laboratory analysis to identify floral buds. Buds collected in March 2012 and sent to the University of Sydney for laboratory analysis via scanning electron microscopy (SEM) in July 2012. <p>Year 2</p> <ul style="list-style-type: none"> Further bud samples collected in July 2013 and November 2013 and microscopy images of floral and vegetative buds finalised in year 3. <p>Year 4</p> <ul style="list-style-type: none"> Dr Tahir Khurshid visited the US in Nov 2014 and discussed microscopy images of floral and vegetative buds with relevant experts.

PC = partner country, A = Australia

Objective 2: Improvement of basic crop management practices and to examine the current irrigation practices and to assess the adaptability of pressurised irrigation system

No.	Activity	Outputs/ milestones	Completi on date	Comments
2.1	Introduction to high density planting (HDP) system (P)	<ul style="list-style-type: none"> • Detailed plan, resource identification • Meeting held to identify the sites (P) • Establishment of HDP (P) 	<p>Nov 2011</p> <p>Yr 1, m11</p> <p>Yr1, m11</p> <p>Yr2, m3</p>	<p>Year 1</p> <ul style="list-style-type: none"> • Detailed planning meeting was held in May 2011 at UAF Faisalabad with all collaborators from Pakistan. Dr Tahir Khurshid and Ms Mary Cannard from Australia participated in the meetings and conducted several workshops. • The following HDP sites were established on grower properties. <ol style="list-style-type: none"> 1. Shaukat Bacha (Manki Sharif), KP. Tree density 555 trees/ha. 2. Haji Mehrab Gul (Kaka Sahib), KP. Tree density 500 trees/ha. 3. Muhammad Javaid Alam, Chak 95, Sargodha, Punjab. Tree density 400 trees/ha. 4. Nawab M. Abdullah, Chak Nawab, Sargodha, Punjab. Tree density 740 trees/ha. 5. A HDP site is also been established at CRI in Sargodha.

2.2	Irrigation management (A & P)	<ul style="list-style-type: none"> • Meeting held to identify irrigation sites and growers properties (P) • One irrigator trained in Australia (A) • Irrigator design and complete the pressurised system (A & P) • Pressurised system installed & running (P) • Flood irrigation modifications to furrows and monitoring via Flume (P) • Training of extension staff in furrow & pressurised irrigation (A) • Training staff complete a report (A) • Water use efficiency trials for Kinnow at Dareton (A) • Results from Flume study reported 	<p>Yr1, m11</p> <p>Yr2, m4</p> <p>Yr2, m11</p> <p>Yr2, m12</p> <p>Yr2, m3</p> <p>Yr2, m11</p> <p>Yr2, m11</p> <p>Yr2, m3</p> <p>Yr3, m3</p>	<p>Year 1</p> <ul style="list-style-type: none"> • Flume training for CRI and ARI staff in Nov 2011. Two project officers and a new irrigation officer were also trained in irrigation management. (Trainer: Tahir Khurshid) • Citrus nutrition workshop was held in May 2012 at CRI. The role of tensiometers and full stop for irrigation monitoring was also demonstrated (Trainers: Steven Falivene, Tahir Khurshid). • Soil solution workshops held for students and extension officers at CRI on 7 May 12 for 15 extension officers and to 60 students UAF on 11 May 2012. (Trainer: Steven Falivene) • Irrigation demonstration sites identified on grower properties in Punjab and KP in Nov 2011. • Furrow irrigation trial established at CRI with Kinnow mandarin in August 2011. Flume data collected from the existing 'Tarocco' furrow irrigation site. • Water use efficiency trial established in August 2011 at Dareton with Kinnow and Daisy mandarin. Sap flow sensors installed in trees. <p>Year 2</p> <ul style="list-style-type: none"> • Drip and sprinkler irrigation systems installed as a demonstration trial on first grower property owned by Mr Mohammad Ilyas, Sargodha. Furrow irrigation demonstration trial also established at the property of Mr Ilyas. Both trials are joint sites with ASLP Social Research project. • Data collected from Kinnow and Daisy mandarin trees in water use efficiency trial at Dareton. Soil solution workshops held for students 11 May 2012 at UAF and for extension officers at CRI on 12 May 2012 (Trainer: Steven Falivene). <p>Year 3</p> <ul style="list-style-type: none"> • Second year of data collected from Kinnow and Daisy trees in water use efficiency trial at Dareton. • The results from the flume study have been collected from the furrow and flow irrigation trials at CRI. <p>Year 4</p> <ul style="list-style-type: none"> • Third year of data collected from Kinnow and Daisy mandarin trees in water use efficiency trial at Dareton.
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PC = partner country, A = Australia

Objective 3: Enhancement the research, extension and production capacity of Pakistan citrus institutes and industry

No.	Activity	Outputs/ milestones	Completion date	Comments
3.1	Training of nursery staff in nursery procedures and practices (A)	<ul style="list-style-type: none"> • Establishment of the detailed plan & identify the potential nurserymen for training • Organise the visas • Organise training in Australia • Training held in Australia • Trainees produced a report 	<p>Yr1, m11</p> <p>Yr1, m11</p> <p>Yr2, m1</p> <p>Yr2, m2</p> <p>Yr2, m4</p>	<p>Year 1</p> <ul style="list-style-type: none"> • Training in nursery management delivered to 19 nurserymen in KP in 16 Jan 2011 (Trainers: 19). • Training of nurserymen in Australia – practical work experience in commercial citrus nurseries (Victorian Citrus Farms and Birdwood) in Nov 2012 (Training coordinators: Nerida Donovan, Ian Bally). <p>Year 3</p> <ul style="list-style-type: none"> • Nursery management training delivered in October 2013 in Islamabad, Sargodha and Faisalabad to nurserymen and women, citrus growers, government officers and university students (Trainers: Tahir Khurshid, Nerida Donovan, Jason Bowes, Inam-ul-Haq). <p>Year 4</p> <ul style="list-style-type: none"> • Nursery management training held in Thailand, November 2014 for Pakistani nurserymen and women, citrus growers, government officers and university students (15 participants / Trainers: Tahir Khurshid, Nerida Donovan, Jason Bowes). • Training in nursery and crop management held in Australia in April 2015 (19 participants / Training coordinators: Tahir Khurshid, Steven Falivene). • Joint citrus and mango nursery manual (Authors: Nerida Donovan, Ian Bally, Tony Cooke. Editor: Susan House) and citrus fact sheets were completed and launched in Pakistan in September 2015. The manual will be published as an ACIAR publication.

3.2	Training of researchers & extension staff in evaluation of varieties, crop management and irrigation (A)	<ul style="list-style-type: none"> • Establishment of the plan, & identify the potential training staff for Australia • Identify irrigation providers for training • Organise the visas • Organise training in Australia • Training held (A) • Training report produced by trainees (A) 	<p>Yr1, m11</p> <p>Yr2, m4</p> <p>Yr2, m6</p> <p>Yr2, m9</p> <p>Yr2, m11</p> <p>Yr2, m11</p>	<ul style="list-style-type: none"> • Training in evaluation of scion and rootstock varieties conducted in May 2012 in Pakistan (Trainers: Tahir Khurshid). • 30 District officers were trained in crop management (fruit thinning) at ATI Sargodha in Oct 2011. • Two project collaborators, Dr Abdul Samad and Mr Asif Khan, were trained in crop and nursery management in Sunraysia, Australia in April 2012. • Irrigation provider (Four Brothers Irrigation Providers) identified to install irrigation systems in Pakistan demonstration trials. • Crop management (fruit thinning) training given to students at UAF on 11 May 2012 (70 participants). • Mega field day held on crop management (fruit thinning and crop nutrition) attended by 500 growers (Trainers: Tahir Khurshid, Steven Falivene). • Project officers and other collaborators were trained in audio visual and still photography (10 participants). Project officers were provided with two video cameras, two still cameras and two SD cards. • Grower conference on crop management (fruit thinning) held on 9-10 May 2012 attended by 200 growers from TobaTek Singh and Sargodha regions. • Training in crop management held in Australia in April 2015 (19 participants / Training coordinators: Tahir Khurshid & Steven Falivene).
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3.3	Attend conferences/workshops (A, Spain, China)	<ul style="list-style-type: none"> To attend and present papers at 12th International Citriculture Congress, Spain Attendance of Pakistan staff at the annual national conference in Australia To attend and conduct a rootstock workshop at Beibei China and Hanoi, Vietnam 	Yr3, m3	<p>Year 1</p> <ul style="list-style-type: none"> Rootstock workshop held in Beibei, China in November 2011. The latest results from the Australian trials of Chinese rootstocks were presented to scientists and postgraduate students at CRI, Beibei Chongqing, China (Presenter: Tahir Khurshid). Tahir Khurshid visited China in May 2012 to discuss the commercialisation of Chinese rootstocks in Australia <p>Year 2</p> <ul style="list-style-type: none"> 2 scientific papers were presented at the 12th International Citrus Congress in Spain in November 2012. Dr Tahir Khurshid and Dr Iftikhar Ahmad attended the conference and networked with international citrus scientists. Workshop on citrus diseases, crop management, germplasm management and rootstock evaluation conducted in Vietiane, Lao PDR in Feb 2013 (Trainers: Tahir Khurshid, Nerida Donovan). <p>Year 3</p> <ul style="list-style-type: none"> Eleven papers (oral and poster) submitted for presentation at the International Horticultural Congress (IHC) in Brisbane in August 2014. <p>Year 4</p> <ul style="list-style-type: none"> 11 papers presented at IHC Brisbane August 2015.
			Yr2, m11	
			Yr2, m3	

PC = partner country, A = Australia

Objective 4: To carry out a scoping study in Pakistan and in 'Kinnow' exporting countries for the development of a citrus supply chain project (2015-2020)

No.	Activity	Outputs/ milestones	Completion date	Comments
4.1	Scoping study for the development of value chain project in citrus (P))	<ul style="list-style-type: none"> Establish a detailed plan and identify the potential partners in Pakistan. Organise the visas for various countries wherever required. Visit Russia, China, UK, Indonesia, Malaysia and UAE. Deliver a workshop and write a detailed report. 	Yr3, m12 to Yr4, m1	<p>Year 4</p> <ul style="list-style-type: none"> Partners identified in Pakistan and other countries. Scoping forum held in Pakistan on 9 Jan 2015. Followed the supply chain from Pakistan to Dubai and Indonesia 13-16 Jan 2015. Met with importers, marketers and retailers and visited markets, retail and wholesale outlets (including hypermarkets). Scoping study report was completed and recommendations made for future work.

7 Key results and discussion

7.1 Objective 1: To introduce germplasm to extend the marketing season and assist in improving nursery production practices for maintaining and multiplying clean material

Seven citrus scion varieties and eight rootstock types were identified as having commercial potential for Pakistan and propagation material of these varieties was imported from Australia. Three insect-free screenhouses were constructed at research institutes for propagation of high health status germplasm. These houses provided the catalyst for another four houses on the properties of commercial nurserymen in Pakistan. The construction of insect-proof facilities will enable the Pakistani citrus industry to produce clean and healthy trees; increasing profitability for nurserymen and women and commercial growers. Eight mother blocks were established in Pakistan for germplasm conservation and to supply propagation material. Pakistani research and extension staff were trained in variety and rootstock evaluation. Women have been empowered in Pakistan as they have been provided with the knowledge, skills and tools to enhance their livelihoods as nurserywomen and expand their businesses to include citrus propagation. Both the Australian and Pakistani citrus industries will benefit from the knowledge gained in Australian variety evaluation trials (with salt tolerant rootstocks) and phenological data collection to aid management of crop load.

7.1.1 Introduction of citrus scion varieties and rootstocks

Citrus scion varieties were chosen based on their maturity periods and suitability to the climate (heat unit mapping) to extend the production window and marketing season in Pakistan by at least 6 months (Figure 1). As can be seen in Figure 1 that harvest season will be extended to 6 months, however, the packing and marketing season will be extended for another 3 months. Therefore, there will be an employment opportunities for people involved in harvesting, packing, and marketing.

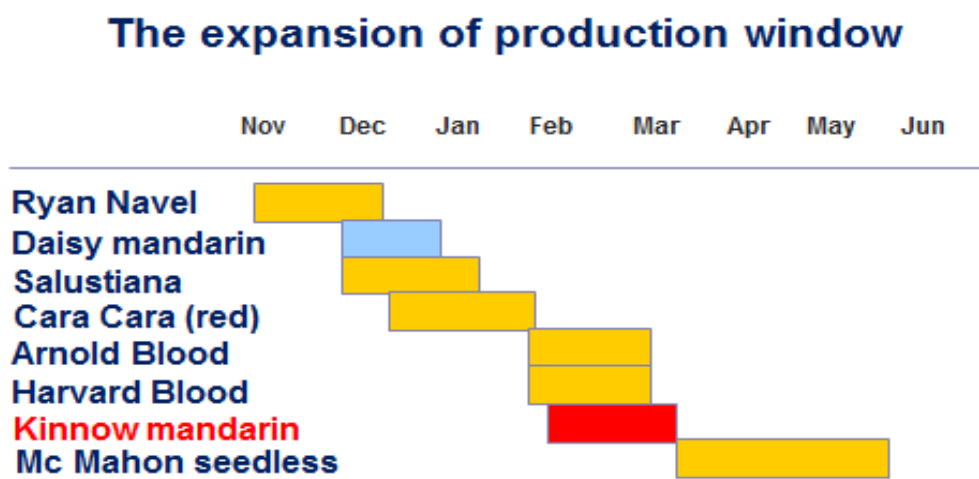


Figure 1: Citrus varieties were selected based on their maturity periods which will extend the citrus production window in Pakistan

Eight rootstock varieties used commercially in Australia and adapted to different soil conditions were chosen (Table 2) to expand the range of soil conditions in which citrus can be grown and reduce issues with *Phytophthora* root rot.

Table 2: Rootstocks exported to Pakistan from Australia

<i>Poncirus trifoliata</i> (Australian strain 22)
Carrizo Citrange (<i>Citrus sinensis</i> x <i>Poncirus trifoliata</i>)
Troyer Citrange (<i>Citrus sinensis</i> x <i>Poncirus trifoliata</i>)
C35 Ruby (<i>Citrus sinensis</i> x <i>Poncirus trifoliata</i>)
Cleopatra mandarin (<i>Citrus reshni</i>)
Benton Ruby (<i>Citrus sinensis</i> x <i>Poncirus trifoliata</i>)
Cox mandarin hybrid (Scarlet mandarin x <i>Poncirus trifoliata</i>)

Seven scion varieties (Figure 2) and eight rootstock types (seeds) were sent to Pakistan from Australia. Budwood and rootstock seed was distributed to the following collaborative research institutes: NARC; CRI; ARI; and UAF.



Figure 2: Citrus budwood for sweet orange and mandarin varieties

Eight mother blocks (scion and rootstock) were established at NARC Islamabad, CRI Sargodha, ARI Tarnab and UAF Faisalabad. These mother blocks will preserve the plant material, serve as a source of propagation material and the replication at several sites will provide functional redundancy in case a mother block is lost. Figures 3 and 4 show an established mother block at NARC, Islamabad.



Figure 3: Field mother block for scion varieties
NARC Islamabad



Figure 4: Field mother block for rootstocks NARC
Islamabad

Mother blocks were also established at government germplasm units (GPUs) in Palai Sherkhana (KP), Sodhi Jaiwali (Punjab) and Muhammad Nagar (Punjab). GPUs are part of the Federal Seed Certification and Registration Department (FSC&RD) whose role is to provide quality control over germplasm through registration of crop variety, crop inspection and seed testing. The new varieties identified with commercial potential through this project (after their evaluation) will require FRC&RD registration prior to being commercially available to growers.

7.1.2 Training in varietal evaluation

Pakistan research and extension officers were provided with training and experience in variety and rootstock evaluation including assessment of fruit yield and quality, fruit size distribution and tree growth. Officers were also trained in principles of rootstock evaluation and how to assess the health and trueness to type of rootstock seedlings. Research and extension workers in Pakistan are now well equipped to evaluate new citrus varieties when trees become commercially productive (seven years old). Comprehensive training packages were developed by the project team to ensure this capability can be extended to other officers beyond the life of the project. Training material can be accessed via the NARC website.



Figure 5: Dr Tahir is briefing about the varietal
characteristics to KP growers in Akkora Khattak

7.1.3 Creating an environment to grow clean, healthy citrus trees

During the project, three insect-free screenhouses were built at NARC (Figure 6), CRI (Figure 7) and ARI (Fif 8) to propagate 'clean', high health status nursery trees in an environment protected by insect pests and insect vectors of citrus diseases. The propagation material and trees are grown for use in research trials and for distribution to industry.

The screenhouses are fully operational, producing healthy propagation material and nursery trees. Field days and workshops were held at these 'model' screenhouses to inform nurserymen of the benefits of having a screenhouse; particularly as the devastating citrus disease, Huanglongbing (HLB), and its associated insect vector, the Asian Citrus Psyllid, are present in citrus orchards in Pakistan.

Pakistani research institutes in NARC, CRI and ARI are now able to produce more than 3000 clean trees per year in these screenhouses, and their nursery staff have been trained in nursery hygiene (particularly given the high health status of the nursery stock), plant propagation (chip budding) and potting mix preparation and management.



Figure 6: Screenhouse built at NARC, Islamabad



Figure 7: Screenhuse at CRI, Sargodha



Figure 8 Screenhouse at ARI, Peshawar (KP)

Training in nursery production practices was given to Pakistani research and extension staff, commercial nurserymen and women and citrus growers in Pakistan, Thailand and Australia. One training activity was conducted in Thailand to expand the experience of both the Pakistani trainees and the Australian team members and to strengthen our international networks.

Joint mango and citrus nursery management training was given to Pakistani nurserymen in Australia from 1-17th November 2012. The training was sponsored by the Agricultural Capability Support fund of the ASLP. Four citrus nurserymen and three mango nurserymen travelled to Sydney for an introductory workshop before dividing into their

commodity groups and travelling to Victoria and Queensland for practical training in production nurseries. Training participants were asked to answer a series of questions about each of the training nurseries and encouraged to take notes and photographs. After the practical training a debrief session was held in Sydney where the training participants provided detailed answers to the questions demonstrating they had acquired a great deal of knowledge during the training. Key points were identified that will benefit nursery production in Pakistan including the use of different potting media components and growing containers to improve drainage and plant growth, chip budding to increase propagation efficiency of citrus, nursery hygiene practices to reduce pest and disease issues, more efficient use of water and fertiliser through modern application methods and the need to improve transport arrangements and supply growers with planting instructions to increase the survival of nursery trees when planted in the field. The highlights from the debrief session focussed the direction for future nursery training activities conducted by the citrus commodity project team.

The key points identified in the joint training were highlighted in subsequent nursery training activities conducted by the citrus commodity project team. Nursery management training sessions are outlined in the Table 3.

Table 3: Nursery management training conducted by the ASLP citrus project team

Activity	Location	Date	Trainers	No. trainees
Workshops and practical work experience in commercial nurseries	NSW DPI, EMAI and Dareton / Victorian Citrus Farms / Birdwood Nursery, Australia	1-17 Nov12	Nerida Donovan, Ian Bally, Jason Bowes, Denis Roe	7 (4 citrus, 3 mango)
Nursery management practices Workshop	Agriculture Training Insititute, Sargodha, Pakistan	19 Feb 2013	Tahir Khurshid, Steven Falivene	37
Workshop – lectures on nursery management and practical sessions on propagation and potting media	National Agriculture Research Centre, Islamabad, Pakistan	4 Oct 13	Tahir Khurshid, Nerida Donovan, Jason Bowes. Demonstration by Inam-Ul-Haq.	50
	Agriculture Training Insititute, Sargodha, Pakistan	5 Oct13		67
	University of Agriculture, Faisalabad, Pakistan	7 Oct 13		77
Topworking field session	UAF, Pakistan	8 Oct 13	Tahir Khurshid, Jason Bowes, Nerida Donovan	19
Field visits to nursery, orchard & packing shed	Thanathon Orchards, Fang Valley, Thailand	24-25 Nov 14	Tahir Khurshid, Nerida Donovan, Jason Bowes. Demonstration by Inam-Ul-Haq. Local coordinator: Sakesan Ussahatanonta	15 + 6 Thai
Topworking field session		24 Nov 14		15 + 6 Thai
Workshop – lectures on nursery management and practical sessions on propagation and potting media	Maejo University, Chiang Mai, Thailand	26-27 Nov 14		
Citrus Nursery raising Techniques	Agriculture Resaerch Insititute, Peshawar, Pakistan	10-12 Feb 2015	Ghulam Nabi and Nisar Neem, Wajid Ali	30

The impact that nursery training has had on commercial citrus enterprises in Pakistan can be demonstrated through case studies. Mr Muhammad Afzaal from Sultan Nursery Farms in Sargodha was one of four commercial nurserymen who undertook practical work experience in Australia in November 2012. Since returning to Pakistan he has assisted with training other nurserymen in his region, he has established a medium sized shadehouse in his nursery, converted some of his field production to containers (Figures 9-11) and has changed to chip budding to improve bud take. The changes mean that he is

now producing a superior product and has raised the sale price of nursery trees from PKR 35 to 100. Mr Afzaal states that demand for his trees has not fallen despite the price increase because he is selling healthier plants that have a greater survival rate in the field, which then means that the grower does not need to buy additional replant stock.



Figure 9: Nursery practices at Sultan Nurseries prior to the screenhouse construction.



Figure 10: A screenhouse was built by Sultan Nurseries to provide a protected growing environment.



Figure 11: Clean and healthy trees are now grown in pots in the Sultan Nursery screenhouse.

Mr Latif-ur Raheem (Figure 12) was also trained in nursery management and plant propagation practices in Australia during 2012. Since his return to Pakistan, Mr Latif-ur Raheem has assisted with training other nurserymen in his region and adopted improved nursery management practices including changing his potting media. Mr Latif-ur Raheem has applied to the Agri Support Fund (ASF) in Pakistan for funding towards the building of a screenhouse. ASF has already assisted two other nurserymen with building screenhouses in their nurseries; Mr Fazal Malik at Sherkhana, KP (Figure 13) and Mr Sohail Aftab at Kot Momin.



Figure 12: Mr Latif-ur-Rehman a nurseryman in KP was trained in Australia during 2012.



Figure 13: Commercial screenhouses at Sherkhana, KP built with assistance from ASF Pakistan.

7.1.4 Empowering Pakistani women in the citrus nursery industry

Women in Pakistan do not work in citrus orchards or packing sheds due to cultural, safety and logistical reasons. However, this project was able to identify an opportunity to involve women in the Pakistani citrus industry and provide them with new skills and business opportunities. There is an NGO run by women in Haripur, District Hazara in KP province called Pakistan Hoslamad Khawateen Network (PHKN) which translates to “Pakistan courageous women network”. Members of this NGO were already running nursery business where they propagate trees in their backyards. Training provided by this project gave women the skills to propagate and maintain healthy, high quality citrus nursery trees for supply to the local industry. In October 2013, 7 Pakistani nurserywomen participated in the nursery training held at NARC in Islamabad. The nurserywomen were also given nursery equipments (including budding knives) to use their new skills in their backyard



Figure 14: Mr Inam ul Haq demonstrating the preparation of potting media to Pakistani nurserywomen in Chiang Mai, Thailand in November 2014.



Figure 15: Nursery women practicing chip budding as a part of the nursery management training Chiang Mai, Thailand in November 2014.

businesses. In November 2014, three progressive nurserywomen were selected from the previous group and participated in training held in Chiang Mai, Thailand in November 2014 (Figures 14 and 15) and two of those also travelled to Australia for an advanced training in April 2015. On their return to Pakistan, the nurserywomen have assisted with training other women in their region and have increased their profit margins due to selling high quality citrus trees to industry.

7.1.5 Establishing Australian trials to benefit both countries

A rootstock evaluation trial was established in April 2013 at a commercial citrus orchard owned by Shane Kay in Bindoon WA (Figure 16) using varieties originally imported from China. Salt tolerant rootstock varieties were identified in trials in deep sandy soils at Dareton DPI research station as part of HIA funded project 'CT03025 National program for screening and evaluation' (2002 to 2007). Bindoon WA was selected for the grower trial because salt levels were higher than those found in Dareton. The Chinese rootstocks with potential salt tolerance included in the trial were Anjiang Hongju, Cao Shixiangju, Zao Yang and Zhoupi Jiangan. Navel variety Houghton was used as the scion variety. Growth data has been collected from the trial trees but as they will not start to produce commercial quantities of fruit until after 2017, it is too early to make recommendations. Further funding will be required to evaluate the potential of these rootstocks for fruit yield, quality and fruit size.



Figure 16: Dr Tahir Khurshid inspecting the Chinese salt tolerant rootstock trial at Bindoon, WA.

Another field trial established at Dareton DPI research station aimed to quantify the flower initiation stage for citrus in the Sunraysia. To date, research conducted at the University of California was used to extrapolate the timing of flower initiation in the Sunraysia (Lord and Eckard, 2005). However, the precise timing was not known and therefore the best time to apply Ralex[®] for flower suppression in citrus was also unclear. Ralex[®] (GA₃ formulation) is applied during the flower initiation stage in the expected 'on-year' to suppress flowering and manage crop load.

During the trial, citrus bud samples were collected (Figure 17) from marked trees and subjected to Scanning Electron Microscopy (SEM) at the University of Sydney. The results indicated that Ralex[®] was able to kill the bud and reduce flowering; although it did not seem to convert the reproductive bud into a vegetative shoot as previously documented (Khurshid and Bevington, 2006).

It was difficult to identify the flower initiation stage under the SEM because at the initiation stage there appeared to be little difference in the physical appearance of vegetative and floral buds.

The scanned image of a floral bud (Figure 18) shows the flower differentiation stage with sepals enclosing petals underneath. Despite the difficulty in identifying flower initiation stage, the subsequent flower development stage was clearly identified in this study. It was concluded that Ralex[®] can be used four to six weeks before 'bud break', which normally occurs in the third week of July in the Sunraysia.

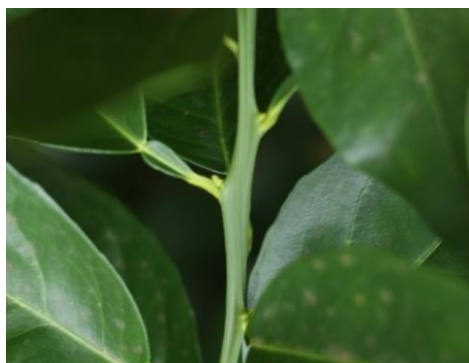


Figure 17: Citrus bud taken during June 2013 from Hockney Navel orange

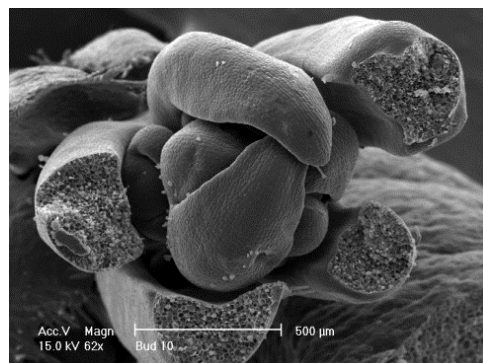


Figure 18: The scanned image of a floral bud for Hockney Navel orange

7.2 Objective 2: Improvement of basic crop management practices, examination of current irrigation practices and assessment of the adaptability of pressurised irrigation systems to Pakistan

Citrus research and extension staff within Pakistan were taught the principles of citrus crop phenology and the importance of managing the crop based on the phenological stage rather than the calendar date. Data specific to the Pakistani citrus industry was also collected from two local trial sites at research institutes and used to create citrus phenological calendars for use by government and industry. Growers were trained in pruning practices to improve tree growth and fruit quality, a fruit thinning field trial demonstrated the benefits of thinning for consistency of yield and a high density tree planting trial was established to create awareness of this option for increasing production per hectare. Irrigation workshops were attended by growers and extension officers from the Punjab and KP to explain the benefits of furrow irrigation methods compared to flood, how to use and install a 'Tensiometer' for irrigation scheduling and how to correlate water

use with soil type. The successful development of four model sites where a Quality Payment System was implemented enabled participating growers to sell their produce straight to market, realising 50% more profit than when they sold via contractors.

7.2.1 Creating an understanding of phenology towards improved crop management

Phenology is the study of tree growth stages. The phenological (growth) stages for each citrus variety vary due to genetic and environmental factors. Understanding growth stages helps growers schedule management practices to encourage healthy plant growth and development. In Australia, phenological stages are used to time the application of cultural practices to citrus trees (Khurshid, 2004), but this practice was not used in Pakistan prior to our project. To improve citrus crop management in Pakistan, this project extended the concept of citrus phenology to Pakistani scientists and extension staff.

Field trials were established at CRI and ARI to not only gather data on the phenological growth stages of Kinnow mandarin and blood orange, but to provide local staff with training in how to conduct such experiments. Data was recorded for two growing seasons on different phenological stages; bud break, flower initiation, full bloom, petal fall, cell division, cell expansion, physiological fruit drop, colour break and maturity. The data was used to produce phenology calendars (posters) for Kinnow mandarin and blood orange. Phenology posters were produced in both Urdu and English languages (Figures 19-21) and were used as training tools to demonstrate the concept of crop phenology to scientists, extension staff and citrus growers. The posters (Figures 20, 21) have been distributed to growers, packing houses and research institutes. Training was provided to scientists and extension officers on how to schedule crop management practices on the basis of phenological stages rather than by calendar date.



Figure 19: Dr Tahir Khurshid conducts phenology training for Pakistani scientists and extension staff.



Figure 20: 'Kinnow' phenology poster in Urdu.



Figure 21: Blood orange phenology poster in Urdu.

Phenology work was also part of the Australian component of the project. A phenology calendar has been produced for the Australian growers in the past. The current trials at Dareton are focussed on gathering information for a range of navel varieties and to observe year to year variations across the phenological stages.

7.2.2 Improved pruning practices

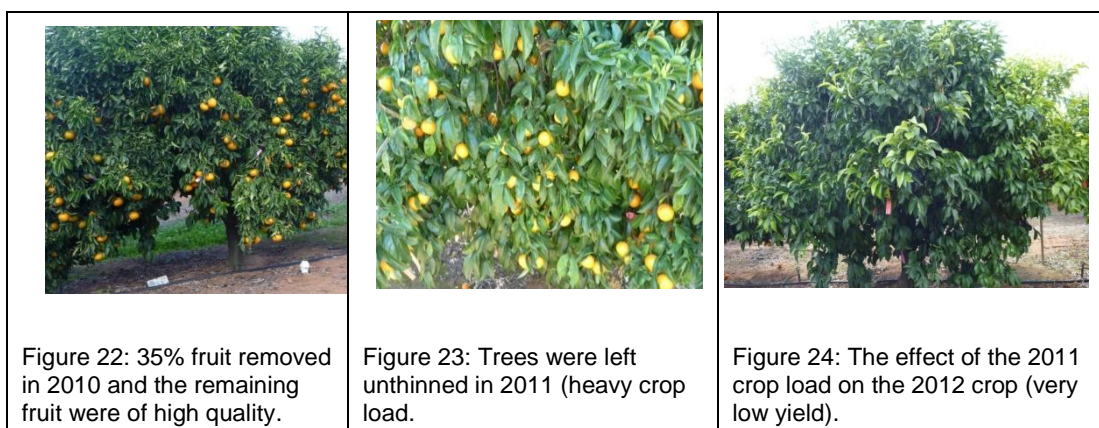
In Pakistan it is not a common practice to prune citrus trees other than the removal of some dead wood after harvest. During the first phase of ASLP, field trials were established at CRI and ARI demonstrating different levels of pruning. Three different pruning treatments were applied; light pruning (removal of 10% wood), medium pruning (removal of 25% wood), and heavy pruning (removal of 35% wood) as well as a control (no pruning).

In Phase 2 of ASLP, training workshops were held on how to prune citrus trees. Trainees were able to make observations at the on-farm demonstration site and were given the opportunity to develop their skills in practical sessions. As a result of training provided through this project, it is estimated that 20% of citrus growers now prune their trees.

7.2.3 Increasing the consistency of yield through fruit thinning

Kinnow mandarin trees are highly biennial in nature, producing a large number of small fruit in an ‘on-cropping’ year and then a small number the following year leading to an under supply of ‘Kinnow’ fruit in the market. The fruit produced in an ‘off-year’ are oversized and unmarketable. Fruit thinning is practiced to enhance fruit size and quality to increase monetary returns and also to reduce the impact of biennial bearing, by encouraging a steady supply of good quality fruit each year. One way to practice fruit thinning is to remove the small, diseased and blemished fruit by hand after the completion of natural fruit fall.

During the project a fruit thinning trial was carried out and fruit (35%) were thinned from the trees in 2010 (Figure 22). Trees were not thinned in 2011 (Figure 23), and consequently the trees bore a heavy crop of small sized fruit. In 2012, trial trees did not bear any fruit (Figure 24) due to the unthinned 2011 fruit load. Data is shown in Table 4.



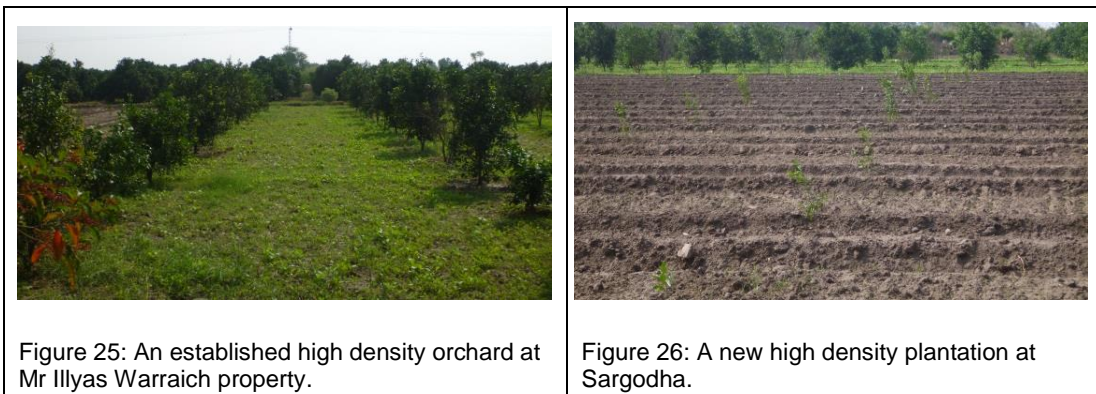
Year of treatment	Treatments	Fruit number	Yield (kg)
2010	No thinning	834	84
2010	35% thinned	518	86
2011	No thinning	1294	126
2012	No thinning	78	9
2013	No thinning	1035	129

This trial demonstrated that fruit thinning in an “on-year” resulted in a higher yield of large sized fruit and reduced the impact of biennial bearing.

7.2.4 Increasing yield through high density planting (HDP) systems

Citrus tree yield in Pakistan is low (14-18 t/ha) compared to citrus yields in Australia (40 t/ha for sweet orange and 60 t/ha for mandarin). Factors contributing to low yields include poor tree management (pest and disease, irrigation, nutrition) and low tree planting densities. In Phase 2 of ASLP, the concept of high density planting (HDP) systems was introduced and high density planting demonstration sites were established at research

institutes and on grower properties (Figures 25 and 26). The trees have not been in the ground long enough for yield data to be available. However, extension staff and growers have been trained in how to collect yield and quality data in preparation for when the trees start to produce commercial quantities of fruit.



7.2.5 Converting from flood to furrow irrigation systems

During the project, a series of workshops were held to train citrus growers from Punjab and KP provinces in irrigation management. Members of the Australian project team were not given departmental approval to visit KP, therefore the extension and growers were invited to Punjab, where workshops were conducted in two locations:

University of Agriculture, Faisalabad (UAF)

70 citrus growers from both KP and Punjab provinces participated in this workshop. The Punjab growers were mainly from Sargodha, Mandi Bahudin and Layyah districts. The growers from KP came from the citrus growing areas of Nowshera, Mardan and District Dir. The predominant citrus grown in the Punjab is Kinnow mandarin and in KP is blood orange.

Bahauddin Zakariya University (BZU), Multan

The extension staff and growers who participated in this training were predominantly from the Multan citrus growing area where Kinnow is the predominant crop.

Theoretical and practical training was design to help participants understand soil water and identify field capacity and wilting point for both citrus and mango crops. Practical training was also given to 70 growers and extension officers on the installation and use of tensiometers, including recommended actions to be taken subject to pressure readings (Table 5).

Table 5. Tensiometer pressure reading and actions to be taken.	
▪	25 – 30 kilo pascal (kpa): Should consider irrigating sandy soils, especially in shallow rooted crops.
▪	40 kpa: Readings should be no higher for vines in spring time.
▪	35 - 60 kpa: Should consider irrigating medium textures soils e.g. Light sandy clay loams to clay loams.
▪	50 – 60kpa: Should consider irrigating heavy textured clay soils.

During this training, 1.5 m deep pits were dug around the root systems of a citrus and a mango tree to demonstrate the depth and breadth of their root systems. Growers were shown the different layers of the soil profile and the root zones of the tree, identifying fibrous and structural root growth. Growers also learnt how to calculate the amount of water required for a particular soil type. Growers were shown furrow irrigation systems

and trained on how to construct furrows under the tree canopy (Figure 28). A flume meter from Australia was installed to measure water flows along the furrows (Figure 27).



Figure 27: Installation of flume meter to measure water flow along furrows.

Figure 28: Furrow irrigation system at CRI, Sargodha.

In KP, the project linked with a flood rehabilitation project. The Agriculture Research Institute (ARI) provided citrus trees to areas affected by devastating floods, distributing trees to 200 one acre sites. Under tree furrow irrigation systems were established in the one acre orchard plots.

Data from furrow irrigation trials demonstrates the practical benefits of the furrow irrigation system in comparison to a flood irrigation system. Furrow irrigation resulted in an increased gross return of 7,300 rupees per tonne (Table 6).

Table 6. Yield/tree, gross returns/acre and profit margin for citrus furrow and flood irrigation systems

Treatment	Yield/tree (tonnes)	Gross returns/acre (rupees)	Gross returns/Tonne	Gross returns/Tonne Difference
Furrow	121	529,412	37,200	7,300
Flood	98	344,272	29,900	

Work is underway at Dareton research institute in Australia to quantify the amount of water required for optimal production of cv. 'Kinnow'. This will aid irrigation scheduling of this citrus variety in Australia and Pakistan.

7.2.6 Establishment of a Quality Payment System (QPS)

Despite not being part of the original project scope, efforts were made to introduce a Quality Payment System (QPS) in Pakistan, and to encourage the growers to market their fruit directly without the need of a contractor. The QPS was set up as a pilot and four QPS sites were established at collaborative grower properties with 'Kinnow' in the Punjab and blood orange in KP (Figures 29, 30). These sites were managed by the growers with assistance from the project team. The growers were provided with a full crop management program including guidelines for scheduling irrigation and the application of fertiliser and pesticides. Project officers and collaborating growers were then able to sell their fruit directly to the market and managed to achieve a 50% increase in profit, compared to when they sold their fruit via contractor. These growers have now decided to increase the

number of QPS sites and the fruit will be directly sold to the markets without the involvement of contractors.



Figure 29: Quality payment site of Mr Illyas Warriach at Sargodha, Punjab.



Figure 30: Quality payment site of Mian Ayaz at Nowshera, KP.

7.3 Objective 3: To enhance the capacity of the Pakistan research, development and extension system to deliver targeted and practical research outputs to agribusiness and growers

The project played a key role in building the capability of research and extension staff, growers, nurserymen and women, and postgraduate students. Training activities in Australia and Pakistan raised the knowledge and skill base of Pakistani research and extension staff in the areas of varietal evaluation, nursery and orchard management (including irrigation management), trial management and new extension methodologies (e.g. self-managed grower groups). Training packages were developed by project team members for use by extension officers and growers. The packages included technical manuals and fact sheets, and model designs for workshops, farmer field schools, and on-farm trials including demonstration blocks. Australian and Pakistani researchers and extension officers gained knowledge and experience through the development and delivery of training modules. It also paved a way for future collaborative research projects beyond the life of this project.

During the project:

- **11** visits to Pakistan were made by Australian team members to run training activities.
- The project trained **494** nurserymen, nurserywomen and growers in Pakistan on nursery management and tree production.
- **7** varieties and **8** rootstocks were introduced to Pakistan.
- **3** screenhouses were established at the research institutes at NARC, CRI and ARI.
- **8** mother blocks were established to maintain germplasm of scion and rootstock varieties.
- **200** participants attended a UAF field day on nursery production.

- **470** growers were trained in crop management such as pruning and reworking techniques. Pruning was **adopted by 20%** of these citrus growers.
- **107** growers were trained in fruit thinning practices.
- **604** growers were trained in furrow irrigation systems. In KP **200** one acre citrus properties were established under a furrow irrigation system, in collaboration with the KP Flood Rehabilitation project. The technology has also been adopted by **400** apricot and peach growers.
- **900** growers were trained on crop management in one 'mega' field day (**600** participants) and 4 small field days (**300 participants**).
- The project published **1** technical nursery manual and **8** training packages. The packages were delivered to the Director General of NARC in September 2015 during the project show case event. The packages are available on the NARC website for use by government and industry.
- **9** printed project newsletters and **43** fortnightly E-newsletters were sent to **399** growers.
- **42** SMS were sent to **1150** growers on crop and irrigation management.
- Project activities were also widely broadcasted on Radio (**36** interviews) and TV (**27** programs).
- A National Citrus Conference was held over 2 days at UAF with **350** participants.
- **92** training sessions and workshops were conducted by the Australian and Pakistan team and there were **106** communication activities including farm visits.
- A total of **55** researchers, extension officers, nurserymen, nursery women, growers and postgraduates' students received training in Australia, Thailand and Spain.
- **9** students completed their postgraduate studies. Of these, Mr Muneer Rehman was able to get a JAF scholarship and he is pursuing a PhD in postharvest physiology at the Curtin University, Perth Australia under the supervision of Dr Zora Singh and Dr Tahir Khurshid.
- **12** lectures were delivered to university students.
- Pakistan project team members attended **5** training courses on project assessment, project evaluation and impact assessment.
- The project established strong links with: the ASLP social and mango production projects; UNIDO; Flood Rehabilitation program in KP; commercial nurseries in KP and Punjab; Agriculture Training Institute Sargodha; and the Agribusiness support fund, Lahore. The project established international links with Maejo University in Chiang Mai and Thanathon Orchards in Fang Thailand. Both venues were used for nursery and crop management training. Links were also established with South China University, Chongqing, PR China.
- The project conducted a value chain scoping study in Pakistan, Dubai and Indonesia to establish a framework for proposed future work (2016-2020).

In summary, the Australian and Pakistani citrus teams involved in this project directly trained a total of **5700** growers – with an estimated **17,100** secondary beneficiaries.

8 Impacts

8.1 Scientific impacts – now and in five years

It will take several years for the economic and social impacts of this project to become clear, although some impacts on scientific practice in Pakistan are evident already.

Research and training activities conducted during this project has significantly increased the knowledge and skill base of Pakistani government officers and industry members, particularly in the areas of nursery production, orchard management, (including crop phenology and on-farm irrigation), and marketing (quality payment systems).

Pakistani researchers and extension officers have been provided with equipment and training. The scientific equipment has been used at agricultural institutes to improve research outcomes. Information has been extended to other members of the extension network to enhance their ability to advise industry.

Collaborative scientists have been trained in varietal evaluation in Australia. Citrus germplasm has been introduced to Pakistan; seven scion varieties as budwood and eight rootstocks types as seed. Trees of the new varieties have been propagated in Pakistan and their commercial potential will start to be evaluated when they reach 7 years of age.

A “best practice” citrus and mango nursery manual has been produced by members of the citrus and mango production project teams of ASLP. Training in nursery management has also been provided to government officers and industry members to increase the scientific knowledge base and skill level within Pakistan. Four nurseries have been established at research institutes (CRI, NARC, UAF and ARI) as model facilities to aid training programs. Insect-proof screen houses were established at 3 of these sites for the multiplication of high health status plant material for use in field trials and for supply to industry.

The collection of heat unit and phenology data in Pakistan led to the development of crop phenology calendars for Kinnow mandarin and blood orange. The calendars are part of a training package delivered to Pakistani scientists and extension officers who are now recommending that growers schedule management practices (e.g. application of fertiliser and plant growth regulators) according to phenological stages rather than relying on calendar dates. Phenology calendars have also been distributed to growers, packers and research institutes to extend the scientific knowledge.

Irrigation efficiency trials in Pakistan have demonstrated to Pakistani scientists and industry members the water savings that can be achieved by changing from flood to furrow irrigation. Improved irrigation efficiency also improves crop health and production. Irrigation information has been delivered to government and industry members during training activities and compiled into training tools for use in future training programs.

Government officers and industry members were exposed to best practice nursery and orchard management during visits to Australia, Thailand and Spain. This knowledge has been taken back to Pakistan where disseminated to others through training activities.

Pakistani scientists attended international conferences to expand their knowledge base and build networks. Project collaborators presented 11 papers at the International Horticultural Congress in Brisbane in 2014 and two papers at the International Society of Citriculture congress in Spain in 2012.

During the project, 9 postgraduate students completed their Masters and PhD degrees. One student was awarded a John Allwright Fellowship to undertake PhD studies at Curtin University in Perth Western Australia.

One Pakistani scientist (Mr Nisar Naeem) has been promoted to Principal Horticulturist largely due to the training and exposure provided by the project. This included training in experimental design, data gathering and data analysis which enables him to advise others working on citrus in Pakistan to improve the scientific integrity of future trial work.

8.2 Capacity impacts – now and in five years

Knowledge, skills and equipment were given to government officers and industry members to improve their capability and capacity in the areas of nursery management, varietal evaluation, orchard management (pruning, nutrition, irrigation), and marketing.

Scientific equipment provided to the Pakistani collaborators includes data loggers, computers, meteorological stations, pruning tools, tensiometers (irrigation monitoring equipment), refractometer, callipers, technical texts (textbooks, manuals, guides and posters). These items increase their capacity to undertake research trials and run training activities to benefit not only citrus, but other horticultural crops produced in Pakistan.

During the project, 8 training packages have been developed which enable Pakistani extension staff to 'train the trainers'. The training packages can be accessed from the NARC website which has a designated area for the ASLP Citrus project. This allows future capacity building beyond the life of the project.

Pakistani collaborators have spread the word about the benefit of improved citrus management techniques. The communication tools used include live talkback radio and television segments, farmer field schools, workshops, newsletters (printed and electronic) and text messages. These communication activities have generated great interest from growers keen to learn these new techniques and apply them to their own farms. Growers are now pruning trees that have never been pruned before and many new plantings are established at a high density to increase productivity.

Nurserymen and women (494) were trained in nursery management and nursery production. Three screen houses were established at ARI, CRI and NARC. Each screen house has the capacity to hold 3000 trees for use in government research trials, for planting out as budwood multiplication trees or for direct distribution to industry. The project has developed the knowledge and skills of female nursery women from Haripur, a marginalised area of KP. The nurserywomen attended training in Islamabad, three were then selected for training in Thailand and two received additional training in Australia. The women are now industry leaders, implementing changes to their own businesses and helping to train other women in their region. They have expressed a keen interest in future projects.

The establishment of four grower demonstration sites (2 in KP and 2 in Punjab) have built the capacity of growers in orchard management. Grower demonstration sites are an invaluable tool for use in training activities as they can visualise practical options for increasing productivity. More than 1860 growers were trained in crop management practices at these sites.

Growers (604) have been trained in how to assess irrigation efficiency, improved methods of scheduling irrigation and improved irrigation methods. Demonstrating the advantages of furrow irrigation versus traditional flood methods has resulted in more than 40% of citrus growers in KP adopting this practice change, which will improve soil and tree health and water use efficiency into the future. The citrus project had a

successful partnership with the KP Flood Rehabilitation Project which contributed to the widespread adoption of furrow irrigation. As part of this link, 200 one acre sites were established in KP where blood orange trees were irrigated by furrow irrigation. This technology has also been adopted by apricot and peach growers, where 400 sites were established under furrow irrigation.

The introduction of scion cultivars from Australia will increase the production window. This will provide more work and for a longer period for those willing to work in the orchard or packing house.

The increase in export opportunities facilitated by this project has led to increased development of citrus orchards, including movement into new production areas. Citrus is now grown in the Nowshera and Mardan regions of KP province, while in Punjab there are new orchards near Lahore and Rawalpindi regions.

8.3 Community impacts – now and in five years

The introduction of new citrus varieties, adoption of improved nursery and orchard management practices and movement into new growing areas, will see greater productivity and industry expansion. This in turn will drive community change due to the positive economic and environmental impacts.

These changes include:

- increased employment, wealth and stability within the citrus growing regions of Pakistan – in line with the ‘Pro-poor’ focus of this project;
- opportunities, empowerment and independence for nurserywomen in Pakistan; and
- positive environmental change due to reduced water and pesticide use and soil cultivation.

8.3.1 Economic impacts

There have been some economic impacts within the life of the project.

Nurserymen and women have increased business opportunities after adopting practice changes learnt through project training activities. Knowledge and skills acquired through training activities has enabled nurserywomen in Haripur to introduce citrus to the range of seedlings they produce in their nursery. They have also been able to attain a greater price for their trees adoption of practice changes which improved the quality of trees produced.

One case study to demonstrate the economic benefit to nurserymen is the example of a nurseryman from Sargodha who introduced practice changes learnt through project training activities and has increased the sale price of nursery trees from PKR 35 to 100, only attainable because the quality of his trees has improved which increases their survival in the field.

Another short-term economic impact has been the direct marketing of fruit from quality payment sites in KP and Punjab, managed by growers using ‘best practice management’ with the assistance of project team members. Direct marketing has seen grower returns increase by 50%. Additional sites have been established and fruit harvested from these sites will be directly sold to fruit markets without the involvement of contractors.

Citrus is a perennial crop, therefore significant economic impact will be long-term. Trees are at least 5-6 years of age before commercial quantities of fruit are produced. The economic impact has not yet been realised in the young orchards established and managed using new management practices. Changes in

management practices take time to implement and once adopted can take three-five years for the benefits to be evident in a commercially grown tree.

Seven citrus scion varieties and eight rootstock types were introduced to Pakistan. High health status, superior quality plants were propagated in insect-proof screenhouses. Mother blocks were established as additional germplasm sources, including at the germplasm units in Punjab and KP. Trees were also given to collaborative growers. It will take another five to 10 years before the commercial potential of new varietal introductions will be realised and the benefits of establishing orchards with healthy, disease free trees will be seen.

Project and extension officers were trained in the functioning of twin furrow irrigation systems. This information was disseminated to growers. The adoption of furrow irrigation and soil water monitoring to allow efficient irrigation scheduling has seen an improvement in fruit quality and yield which has resulted in an increased financial return for the growers. Growers were able to earn an additional 7300 rupees/acre for fruit produced under furrow irrigation compared to fruit produced under flood irrigation. The citrus component built a strong link with the 'Flood Rehabilitation Project' (funded by the KP government). The linked project has taken up the technology from our training and established 200 one acre citrus sites using furrow irrigation in the citrus growing areas of KP. The information flowed to other crops in KP such as apricots and peaches. This is an enormous benefit to the growers of KP who not only grow citrus and other tree crops.

8.3.2 Social impacts

This project has strengthened communication networks and links between government officers and industry; including researchers, extension officers, contractors and growers. As a direct result of project activities, government and industry members can access information on modern 'best practice management' for citrus production systems. This has already led to increased returns and expansion of the Pakistan citrus industry which gives individual farm households additional funds to spend on food, health and education and increases employment opportunities for farm workers. Citrus fruit is a valuable source of nutrition therefore an improvement in the quality and abundance of citrus will have health benefits for the greater community.

8.3.3 Environmental impacts

The adoption of improved management practices recommended by the project will result in environmental benefits.

- Healthier trees will result in a reduction in the use of pesticides.
- Reduced soil cultivation will reduce erosion and air pollution.
- Improved irrigation systems and scheduling will lead to more efficient water use and reduced salinity.
- More efficient use of fertiliser will reduce leaching of nutrients into waterways.

8.4 Communication and dissemination activities

Communication and knowledge transfer was a key focus of this project. A wide range of communication and extension activities occurred to build the knowledge and skills of government officers and industry members and to encourage adoption of new cultural practices.

The following points outline some of the major impacts of project communication and extension activities:

- The adoption of furrow irrigation in 200 (1 acre) citrus orchards and 400 (1 acre) orchards of apricot and peaches in KP for more efficient use of water.
- The adoption of chip budding by nurserymen to improve budtake and productivity.
- The growing of nursery trees in containers within greenhouses with improved hygiene practices to improve tree health and transplant survival.
- Several nurserywomen are now more skilled and earning higher incomes for the citrus trees they produce.
- The adoption of pruning and fruit thinning by growers to improve tree health and productivity.
- The adoption of high density planting systems to improve land use productivity.
- The establishment of 4 Quality Payment Sites and a direct marketing system to increase grower returns.

A full list of the training workshops, communication and dissemination activities are given in Appendix 5.

8.5 Training Packages

During the project life 8 training packages were developed. The tools have been used in training activities and are available via the NARC Website.

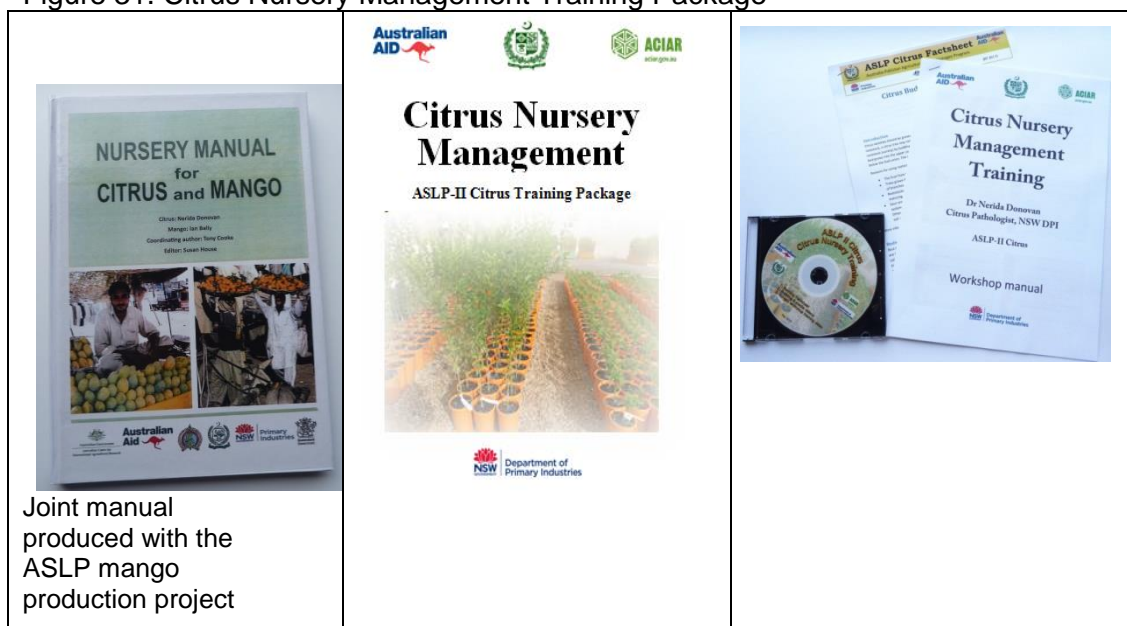
(1) Citrus Nursery Management

The key to a successful and productive orchard is to start with healthy nursery trees. Traditional nurseries in Pakistan operate below world's best practice. The focus of nursery training activities was to introduce practical, low cost practice changes to improve returns and drive further change. The training package (Figure 31) provides comprehensive information to enable nurserymen (with the help and advice of government officers) to adopt 'best practice management'.

The training package contains:

- Comprehensive technical manual for citrus and mango.
- Citrus Nursery Management (Powerpoint).
- Chip budding fact sheet.
- Chip budding video.
- Potting media preparation video.
- Four videos from practical nursery workshops.
- One video from Mr Muhammad Afzaal nursery, Sargodha.

Figure 31. Citrus Nursery Management Training Package



(2) Citrus Rootstock and Scion Varieties

One variety of mandarin dominates citrus production in Pakistan, with blood oranges also grown in smaller quantities. Only 2 rootstocks, rough lemon and sour orange, are used. New scion varieties were introduced to Pakistan to increase the production window, and new rootstock varieties were introduced to improve disease tolerance, increase the number of environments in which citrus can be grown and improve fruit quality. During the project, scientific and extension staff were trained to evaluate the horticultural potential of citrus varieties and a training package developed to aid dissemination of information (Figure 32).

The training package contains:

- Variety fact sheets.
- Rootstock fact sheets.
- Training in variety and rootstock evaluation (PowerPoint).

Figure 32 Citrus Rootstocks and Varieties Training Package



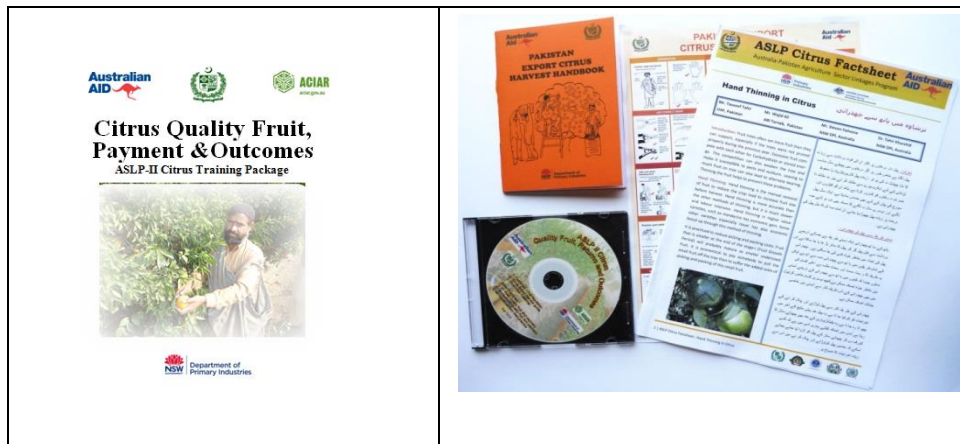
(3) Citrus Quality, Fruit Payments & Outcomes Package

Managing trees is an issue in the citrus industry in Pakistan, with nearly 30-40% fruit lost due to poor harvest and handling techniques, and poor fruit quality due to blemish and disease. Therefore, training material and videos were developed (Figure 33).

The training package contains:

- Crop regulation fact sheets.
- Crop management calendar which outlines the use of different management practices according to phenological stages.
- Phenology poster on 'Kinnow' mandarin.
- Phenology poster on Blood oranges.
- Harvest poster of harvesting techniques.
- Harvest handbook.
- Three videos at the growers' properties of Mr Hammad Tarar, Mr Muhammad Ilyas.

Figure 33. Citrus quality, fruit payment and outcomes package



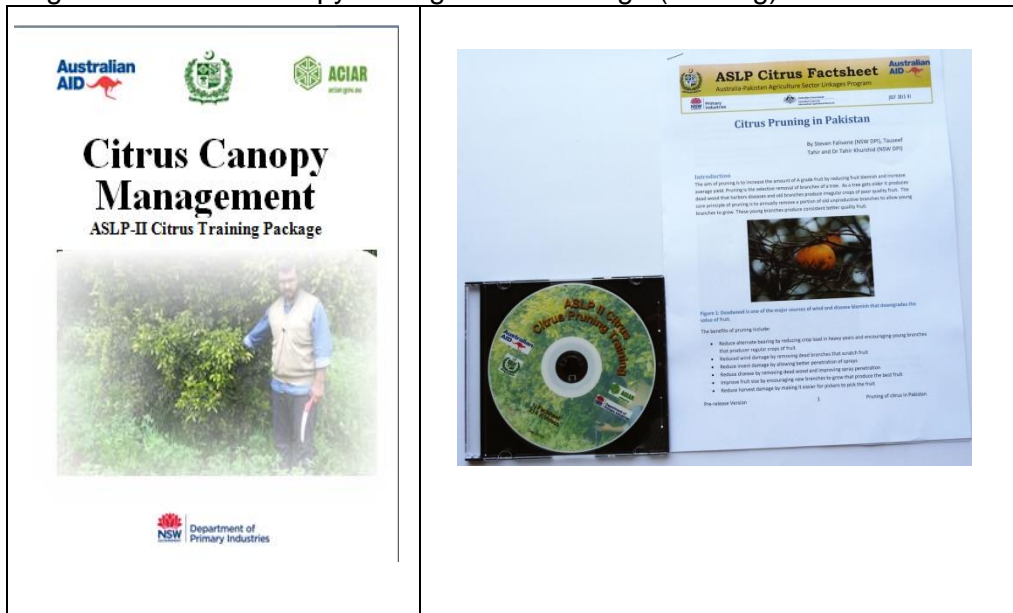
(4) Citrus Canopy Management Package (Pruning)

In Pakistan pruning is not widely practiced and considered to be a waste of crop and resources according to many growers. However, pruning is routinely carried out in modern citrus orchards around the world as it is very important to improve ventilation, improve flush and fruit quality and reduce the incidence of pests and disease. During the training sessions emphasis has been placed on pruning citrus trees in grower's orchards.

The training package (Figure 34) contains:

- Four Pruning videos.
- Fact sheet on how to prune citrus trees.
- Pruning techniques (Power point presentation in Urdu and English).

Figure 34. Citrus Canopy Management Package (Pruning)



(5) Citrus Reworking Package

Reworking is a technique where the top of the tree is removed and replaced with a new scion; it is a quick way to replace a fruit variety without replacing the whole tree. Reworking is also used to for varietal evaluation trials to reduce the time taken to assess the tree. Trees can bear fruit within three years of reworking, as opposed to 5-7 years for a grafted nursery tree. Reworking techniques had never been used in Pakistan before the ASLP citrus project. During the project life, trainers have been training in reworking techniques.

The training package (Figure 35) includes:

- Fact sheets on reworking techniques.
- Four videos on reworking techniques.

Figure 35. Citrus Reworking Training Package



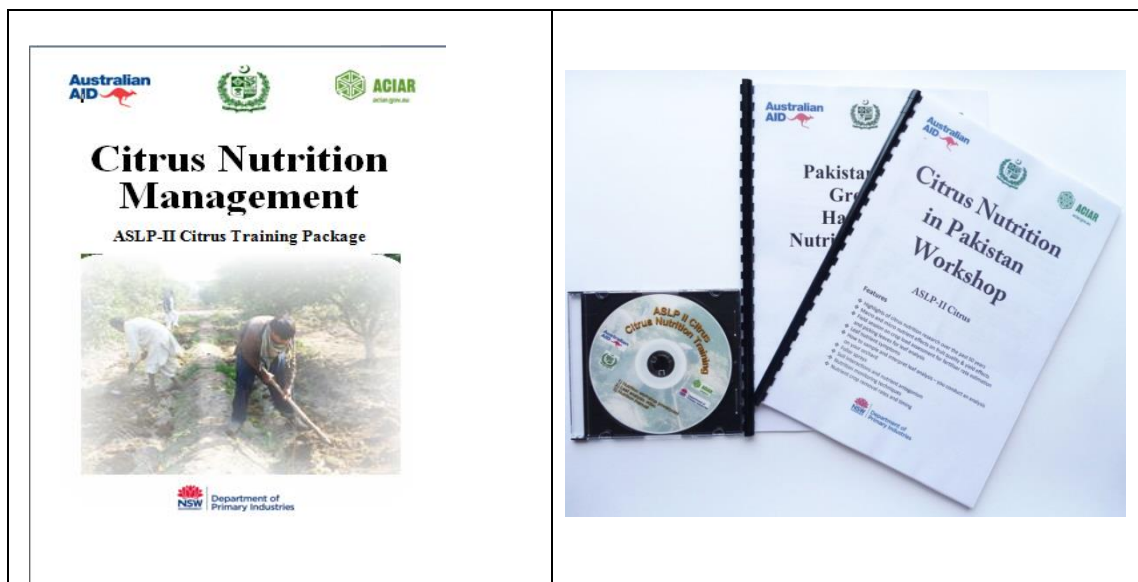
(6) Citrus Nutrition Management Package

In Pakistan there is lack of knowledge on the use of fertilisers in citrus. Leaf analyses were not performed to allow growers to work out what and how much nutrition was required to encourage optimal tree growth and production. A citrus crop management calendar was produced to help growers apply fertiliser to meet the needs of the different phenological (growth) stages of the tree.

The training package (Figure 36) contains:

- A nutrition manual.
- Eight PowerPoints on Citrus nutrition workshops.
- Leaf analysis videos.

Figure 36. Citrus Nutrition Management Training Package



(7) Irrigation Management Package

In Pakistan, flood irrigation is traditionally used to irrigate citrus nurseries and orchards. Under flood irrigation, the grower has limited control over the amount of water applied. The water requirement of citrus trees varies depending on growth stage. Too little or too much water can be detrimental to tree growth and production. Rough lemon rootstock, used widely for Kinnow in Pakistan is prone to waterlogging and is susceptible to root pathogens. Another disadvantage of flood irrigation systems is that water comes into contact with the trunk causing damage to the trunk tissue and makes it more vulnerable to other conditions.

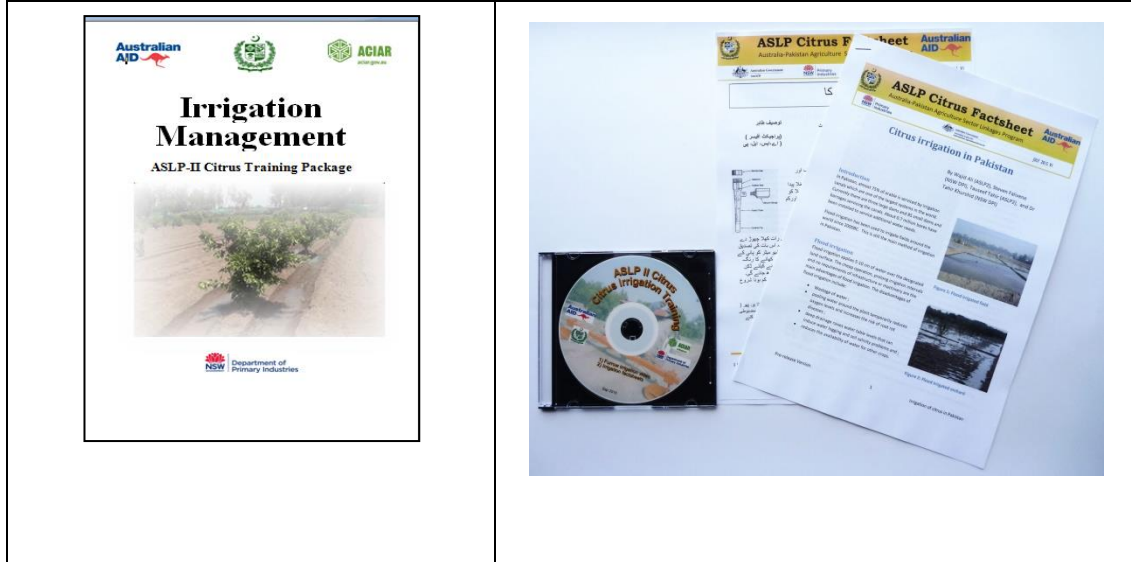
Therefore, the viability of both furrow and pressurised irrigation systems were tested during the project. Furrow irrigation has been a success in both Punjab and KP since it is easy to establish and does not require expensive infrastructure (as compared to pressurised irrigation systems). Training has been provided in the use of irrigation systems. Training was provided during the project irrigation systems, water monitoring and scheduling.

The training package contains (Figure 37):

- Video on furrow irrigation systems.

- Irrigation in Pakistan Fact sheet.
- Tensiometer Fact sheet.

Figure 37. Irrigation Management Training Package



(8) Citrus Best Practice Australian Study Tour Package

In April 2015, 19 Pakistani males and females visited Australia to gain knowledge of the citrus industry and be trained in different nursery and crop management practices. The group comprised 6 growers, 2 nurserymen, 2 nurserywomen, 3 researchers, 2 project officers, 2 extension officers, and 2 postgraduate students. Nine videos were developed on the group experiences and training in Australia, and compiled into a training package (Figure 38).

Figure 38. Australian Study Tour Training Package



9 Conclusions and recommendations

9.1 Conclusions

HORT/2010/002 focussed on four objectives; introduction of new germplasm and improvement of nursery management practices, improvement of crop management practices, enhanced capacity of government and industry, and determining opportunities for further enhancement of the supply chain. Project activities contributed to significant progress in each of the focus areas.

Citrus scion and rootstock varieties were introduced to Pakistan to extend the production season and growing areas. The expanded production will lead to increased wealth in farm households and more job opportunities for poor and marginalised groups who work in the field and packing houses. Labour will be needed for seven months of the year rather than three. Eight mother blocks containing trees of scion and rootstock varieties were established at research institutes and government run germplasm units. Three screenhouses were built with project funds to propagate trees healthy trees and serve as model nurseries for demonstration to industry. Four screenhouses were built by the progressive nurseries to produce healthy trees. Practice changes implemented after attending project training activities has resulted in improved quality and survival of nursery trees and increased returns. Enhanced business opportunities were given to nurserywomen from KP as a direct result of training provided by the project.

Adoption of improved crop management practices resulted in water savings, yield and quality increases and greater returns. Training activities focussed on pruning, fruit thinning, crop phenology, reworking, nutrition, irrigation and direct marketing. Fifteen percent of growers are now scheduling crop management practices according to the phenological periods rather than calendar date. Tree pruning and fruit thinning was introduced and trials have been successful to demonstrate benefits of tree pruning on fruit size and fruit quality; while fruit thinning was able to manage the biennial bearing cropping cycle. Twenty percent of growers are now practicing tree pruning in citrus. It was demonstrated that growers were able to make an additional PKR 7300 per acre under furrow irrigation system compared to flood irrigation. The project linked with the KP government funded "Flood Rehabilitation Project" and was able to upscale the furrow irrigation system with the establishment of 200 (1 acre) furrow irrigation citrus orchards in KP. Furrow irrigation was also implemented in 400 (1 acre) apricot and peach orchards in KP.

This project was able to introduce a quality payment system to growers in Punjab and KP where growers used best practice management to produce high quality fruit and sold their high quality fruit direct to the markets without the involvement of a contractor (middleman). It was demonstrated that growers obtained an additional 25% profit when they sold their A-grade quality fruit via contractor, although the growers made 50% additional profit when they sold the fruit directly to the market. Growers plan to market their best quality fruit directly in future.

The project has a strong focus on building the capacity of scientists, extension staff, growers, nurserymen and nursery women. Training was provided in Pakistan, Australia and Thailand to increase their scientific knowledge and skill base in citriculture. The Fruit and Vegetable Development Project (FVDP) ran highly successful Farmer Field Schools to further disseminate information. Mega field days and workshops were held on nursery management, pruning, fruit thinning, nutrition, re-working, furrow irrigation and irrigation scheduling. The project was able to produce 9 postgraduate students who completed their studies in citrus nursery and crop management. The project linked with the women's NGO PHKN and was able to empower women in nursery management and production.

A scoping study was conducted following the citrus postharvest value chain to identify issues and opportunities for future work. As part of the scoping study, a citrus industry forum was held in Pakistan attended by postharvest scientists, pathologists, contractors, exporters, wholesalers, and retailers. Visits were made to countries to which Pakistan exports Kinnow; Dubai and Indonesia. It was concluded that there is an urgent need to work on the causes of citrus blemish which downgrades fruit quality and reduces export opportunities. Work is also needed on postharvest and marketing issues along the value chain.

This citrus project launched eight training packages in September 2015 to build knowledge and skills to benefit the Pakistan citrus industry.

The project was favourably reviewed by external experts and deemed a success in Pakistan.

9.2 Recommendations

The ASLP Phase 2 citrus project has delivered research and extension outcomes to benefit the Pakistan citrus industry. Additional work beyond the scope of the original project included the establishment of a quality payment system, and the empowerment of women in nursery businesses.

The following recommendations need to be considered to build upon work that has been conducted to date and continue the momentum to drive further change and improvement:

- **Nursery:** evaluation of the commercial potential of introduced varieties, greater access for industry to disease-free nursery trees, and identify a commercialiser to provide potting media to nurseries in Pakistan.
- **Furrow irrigation:** further extension of furrow irrigation in 'Kinnow' growing areas, resolve the issue of timing of water availability to make water available when it is needed.
- **Introduction of low seeded Kinnow:** internal industry politics has delayed the commercialisation of a seedless Kinnow which has enormous domestic and export potential.
- **Quality payment system:** expand the program for greater benefit.
- **Women empowerment in nursery and marketing:** increase opportunities for women in the citrus nurser industry through training opportunities and explore opportunities for value-added citrus products (e.g. jams and marmalades).
- **Value chain:** increase export opportunities by resolving blemish and other post-harvest issues to increase export outturns. Project collaborators have already been identified in Pakistan and Australia for a future project. It is recommended that citrus work be included in Agriculture Value Chain Collaborative Research (AVCCR).

9.3 Australian project team visits to Pakistan

The Australian Team visits to Pakistan (Appendix 1(11.1) for trip details)

Visit 1: Tahir Khurshid – Jan 2011

Visit 2: Tahir Khurshid and Mary Cannard – Oct 2011

Visit 3: Tahir Khurshid and Steven Falivene – May 2012

Visit 4: Tahir Khurshid and Jeremy Giddings – Sep 2012

Visit 5: Tahir Khurshid and Steven Falivene – Feb 2013

Visit 6: Tahir Khurshid– Apr 2013

Visit 7: Tahir Khurshid, Nerida Donovan and Jason Bowes – Oct 2013

Visit 8: Tahir Khurshid, Steven Falivene and Nerida Donovan – Feb 2014

Visit 9: Tahir Khurshid and Jeremy Giddings – Apr 2014

Visit 10: Tahir Khurshid, Steven Falivene and Gerard McEvelly – Jan 2015

Visit 11: Tahir Khurshid and Steven Falivene – Sep 2015

9.4 Pakistan project team visits to Australia, Thailand and Spain

(Appendix 2 (11.2) for trip details)

Visit 1: Training of Pakistani project officers, Australia (20 Aug-3 Sep 12)

Tauseef Tahir and Wajid Ali

Visit 2: Training of Pakistani Nurserymen, Australia (1-17 Nov 12)

Shaukat Ali, Daud ur Rehman, Muhammad Afzaal and Latif ur Rahim

Visit 3: IHC Congress, Spain (13-26 Nov 12)

Dr Iftikhar Ahmad, Dr Tahir Khurshid, Dr Jaffar Jaskani and Dr Ghulam Nabi

Visit 4: Nursery & crop management training, Chiang Mai Thailand (9-26 Nov 14)

Dr Tahir Khurshid, Dr Nerida Donovan, Mr Jason Bowes, Abdul Samad, Nisar Naeem, Inam-ul-Haq, Suleman Luk, Muhammad Javed, Abdul Aziz, Irum Fatima, Samina Naz, Iffat Kalsoom, Nergis Fatima, Ammara Saeed, Humaira Khan

Visit 5: Training in the Sunraysia growing region and Conference, IHC Brisbane (9-26 Aug 14)

Dr Iftikhar Ahmad, Dr Hafeez-ur-Rahman, Tauseef Tahir, Wajid Ali, Dr Muhammad Jaffar Jaskani, Ahmad Raza. Ghulam Nabi, Nisar Naeem, Dr Tahir Khurshid, Dr Nerida Donovan, Mr Steven Falivene, Dr Munawar Kazmi. Ayesha Arif and Asif Khan

Visit 6: Training and Industry Exposure trip, Australia (16 Apr-2 May 15)

Mr Nisar Naeem, Mr Abdul Rahman, Mr Akbar Hayat, Tauseef Tahir , Mr Wajid Ali, Mr Muhammad Illyas, Suleman Luk, Mr Muhammad Hamad Tarrar, Mr Nobat Khan, Mr Mian Ayaz Khattak, Mohammad Aziz, Hastam Khan, Samina Naz, Iffat Kalsoom, Shahbaz Ahmad, Sajid Ahmad, Hafiz Ghafoor, Nergis Fatima and Ammara Saeed

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10.2 List of publications produced by this project

(Appendix 9.3 for Abstracts)

- Wajid, A, Khurshid, T, Naeem, N, Samad, A, Nabi, G and Giddings, J. 2014.** The effect of furrow and flood irrigation system on water use efficiency and yield of sweet orange under ASLP citrus project with assistance from Australian aid program. International Society of Horticultural Science Conference, Brisbane, Australia.
- Tahir, T, Falivene, S. G., and Khurshid, T. 2014.** Hand thinning in 'Kinnow' mandarin to increase the size and quality of fruit under the

ASLP citrus project in Pakistan with assistance from the Australian aid program. International Society of Horticultural Science Conference, Brisbane, Australia.

3. **Ahmed, R., Khurshid, T., Rahman, A., Rahman, A. U., Hayat, A., and Zaka, M. 2014.** The Comparison of Furrow and Flood Irrigation system in 'Kinnow' mandarin under an Australian aid program. International Society of Horticultural Science Conference, Brisbane, Australia.
4. **Nisar, N., Nabi, G., Samad, A., Khurshid, T. 2014.** Evaluation of sweet orange (*Citrus sinensis*) scion varieties on Bigarade rootstock in Malakand district under the ASLP citrus project. International Society of Horticultural Science Conference, Brisbane, Australia.
5. **Muhammad, J. J., Shafqat, W., Tahir, T., Khurshid, T. and Rahman, H. 2014.** Effect of rootstock types on leaf mineral composition in three commercial citrus scion varieties of Pakistan. International Society of Horticultural Science Conference, Brisbane, Australia.
6. **Khan, M. A., Khurshid, T., Shahbaz, M. and Ahmad, S. 2014.** The extension activities of citrus project in Pakistan with assistance from the Australian aid program. International Society of Horticultural Science Conference, Brisbane, Australia.
7. **Ur-Rahaman, H., Nabi, G., Ali, I., Tahir, T. and Ahmed, M. 2014.** Effect of Orchard Floor Management Practices on Soil Properties, Growth and Yield of 'Kinnow' (*Citrus reticulata* Blanco). International Society of Horticultural Science Conference, Brisbane, Australia.
8. **Ahmad, I., Khurshid, T., Jaskani, J., Naeem, N., Nabi, G., Hayat, A., Tahir, .T, Ali, W. and Ur-Rahaman, H. 2014.** Enhancement of citrus industry through improved production practices in Pakistan under the AusAid Program. International Society of Horticultural Science Conference, Brisbane, Australia.
9. **Donovan, N. J., Khurshid, T. and Falivene, S. G. 2014.** Improving citrus nursery production practices in Pakistan under the Australian aid program. International Society of Horticultural Science Conference, Brisbane, Australia. Full paper Acta Horticulturae (in press)
10. **Khurshid, T. 2014.** The Response of Phenological Stages to Climatic Extremes and its Effects on Citrus Production and Quality. International Society of Horticultural Science Conference, Brisbane, Australia.
11. **Falivene, S. G., Khurshid, T., Tahir, T., Wajid, A., and Kazmi, M. R. 2004.** Introduction of a more effective 'Kinnow' mandarin fruit payment system in Pakistan under Australian Aid project. International Society of Horticultural Science Conference, Brisbane, Australia.
12. **Khurshid, T., Jaskani, M. J., Nabi, G., Tahir, T., Ali, W., Rahman, A., Khan, M. A. and Rahman, H. 2012.** Enhancement of citrus value chain production in Pakistan and Australia under the AusAid


Program. International Society of Citriculture Science Conference, Valencia, Spain.

13. **Khurshid, T. Sanderson, G. and Donovan, N. 2012.** The evaluation of Chinese rootstock for tree growth, yield and quality of Lane Late oranges grown in Australia. International Society of Citriculture Science Conference, Valencia, Spain.


10.3 List of extension material produced during project


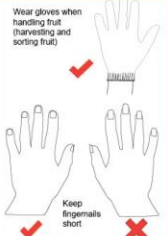
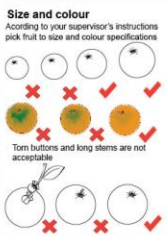
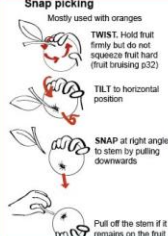
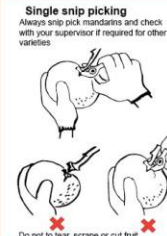
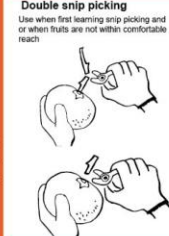
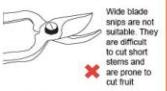






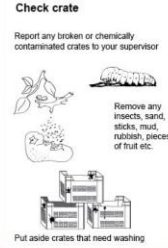
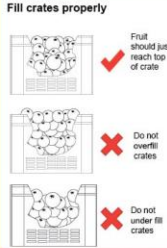


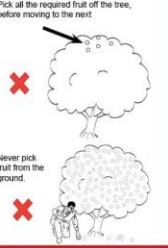

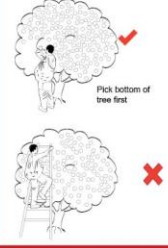


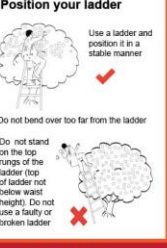



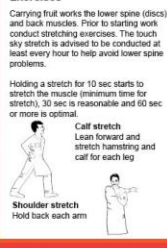

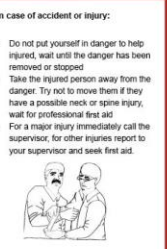
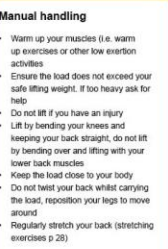

1. Citrus Harvest calendar (Figure 39)
2. Pakistan Export Citrus Harvest Guide (Figure 40)
3. Training manuals produced during the project (Figure 41)
4. Fact sheets produced during the project (Figurs 42)
5. FVDP Website used for extension purposes (Figure 43)
6. SMS system used for the extension purposes (Figure 44)
7. 9 News letters produced during the project (Figure 44)
8. Farne Filed Schools were held during taining for extension (Figure 45)

Figure 40. Pakistan Export Citrus Harvest Guide




PAKISTAN EXPORT CITRUS HARVEST GUIDE




PREPARATION		PICKING PRACTICES			
<p>Clothes, bags and gloves Wear appropriate clothing.</p>  <p>Hat Eye protection Clean gloves Long sleeves Winter: warm clothing Summer: loose clothing Correctly sized picking bag Closed shoes</p>	<p>Wear gloves when handling fruit (harvesting and sorting fruit)</p>  <p>Keep fingertips short</p>	<p>Size and colour According to your supervisor's instructions pick fruit to size and colour specifications</p>  <p>Tom buttons and long stems are not acceptable</p>	<p>Snap picking Mostly used with oranges</p>  <p>TWIST. Hold fruit firmly but do not squeeze fruit hard (fruit bruising p32)</p> <p>TILT to horizontal position</p> <p>SNAP at right angles to stem by pulling downwards</p> <p>Pull off the stem if it remains on the fruit</p>	<p>Single snip picking Always snip pick mandarins and check with your supervisor if required for other varieties</p>  <p>Do not to tear, scrape or cut fruit</p>	<p>Double snip picking Use when first learning snip picking and/or when fruits are not within comfortable reach</p> 
USE CORRECT SNIPS		FRUIT HANDLING			
<p>Wide blade snips are not suitable. They are difficult to cut short stems and are prone to cut fruit</p>  <p>Narrow blunt end fruit and vegetable snips are suitable</p>  <p>Blunt end narrow nose clippers are best</p> 	<p>Stems must be short, no more than 1mm from base of button. Long stems can damage other fruit.</p>  <p>Base of button</p>  <p>Keep snips sharp</p> 	<p>Place fruit in crates Crates will stop soil diseases, insects and other contaminants spoiling the fruit</p>  <p>Never place fruit on the ground</p>	<p>Check crate Report any broken or chemically contaminated crates to your supervisor</p>  <p>Remove any insects, sand, sticks, mud, rubbish, pieces of fruit etc.</p> <p>Put aside crates that need washing</p>	<p>Fill crates properly</p>  <p>Fruit should just reach top of crate</p> <p>Do not overfill crates</p> <p>Do not under fill crates</p>	<p>Unloading the picking bag Use a cloth at least 120cm wide to make the picking bag. Tie the ends short to ensure the exit hole is as wide as possible</p>  <p>Narrow hole at end of bag will restrict the flow of fruit possibly damaging fruit</p>
FRUIT HANDLING					
<p>Take care when Handling fruit Citrus fruit can damage or bruise easily (oleocellosis p34) Place fruit gently into crate</p>  <p>Raising the crate will make should roll out of bag and it easier to unload and cause less fruit damage</p> <p>Fruit should not fall, it is easier to unload and cause less fruit damage</p>	<p>Pick all the required fruit off the tree, before moving to the next</p>  <p>Never pick fruit from the ground</p>	<p>Do not pass fruit down</p>  <p>Climb down the ladder to unload fruit</p>	<p>Do not overfill bags (maximum 12kg), they are a health hazard and can damage fruit</p>  <p>Pick bottom of tree first</p>	<p>Carrying crates carefully Get help when lifting and lowering crates, carry crates carefully</p>  <p>Carefully handle crates of fruit</p> <p>Do not drop crates of fruit</p>	<p>Do not overfill bags (maximum 12kg), they are a health hazard and can damage fruit</p> 
SAFETY					
<p>Position your ladder</p>  <p>Use a ladder and position it in a stable manner</p> <p>Do not bend over too far from the ladder</p> <p>Do not stand on the top rungs of the ladder (top of ladder not below waist height). Do not use a faulty or broken ladder</p>	<p>Do not climb on two or more crates</p>  <p>Do not climb trees</p> 	<p>Personal safety Do not work if injured, sick or incapable of manual work</p>  <p>Do not work under the influence of drugs</p> <p>Bring adequate food and water. Take regular breaks and keep hydrated</p>	<p>Food safety Wash hands with soap after using the toilet</p>  <p>Cover all cuts and wounds</p>	<p>Exercises Carrying fruit works the lower spine (discs) and back muscles. Prior to starting work conduct stretching exercises. The touch sky stretch is advised to be conducted at least every hour to help avoid lower spine problems.</p> <p>Holding a stretch for 10 sec starts to stretch the muscle (minimum time for stretch). 30 sec is reasonable and 60 sec or more is optimal.</p> <p>Call stretch Lean forward and stretch hamstring and calf for each leg</p> <p>Shoulder stretch Hold back each arm</p>  <p>Arm stretch Push arms forward</p> <p>Touch sky stretch Raise arms, stretch upward to "touch the sky" and arch back backwards. This exercise is good to conduct every hour during picking.</p> <p>The following exercises are good for at home for lower disc health and to reduce back pain. These are similar to the touch sky stretch.</p> <p>Stretching before and after manual work can reduce muscle soreness by reducing micro muscle tears and lactic acid build up (increased circulation)</p>	
ACCIDENTS	MANUAL HANDLING		OLEOCELLOSIS		
<p>In case of accident or injury:</p> <ul style="list-style-type: none"> Do not put yourself in danger to help injured, wait until the danger has been removed or stopped Take the injured person away from the danger. Try not to move them if they have a possible neck or spine injury, wait for professional first aid For a major injury immediately call the supervisor, for other injuries report to your supervisor and seek first aid. 	<p>Manual handling</p> <ul style="list-style-type: none"> Warm up your muscles (i.e. warm up exercises or other low exertion activities) Ensure the load does not exceed your safe lifting weight. If too heavy ask for help Do not lift if you have an injury Lift by bending your knees and keeping your back straight, do not lift by bending over and lifting with your lower back muscles Keep the load close to your body Do not twist your back whilst carrying the load, reposition your legs to move around Regularly stretch your back (stretching exercises p.28)  <p>Do not bend back, a curved back whilst lifting can damage the spine</p> <p>Keep back straight whilst lifting and ask for help when necessary</p>		<ul style="list-style-type: none"> Oleocellosis is a rind injury that can occur when harvesting too roughly (i.e. fruit squeezed or bumped) or during unsuitable weather conditions. It is caused when rind oil cells break and the oil burns the rind. A dark bluish on the rind with a soggy sunken surface appears within two to four days. Ripped rind oil cells may be visible in the damaged areas. Damage can lead to fruit decay. Fruit are most susceptible when the rind is targeted (soaked) with water from: <ul style="list-style-type: none"> Cold weather (below about 13°C) Water on fruit (rain or morning dew) Recent irrigation or rain (this is charged with water) 	<p>This poster is a sub-product of the Pakistan-Australian Centre for International Agriculture Research (PACAR), Department of Foreign Affairs and Trade (Australian Aid) and NSW Department of Primary Industries funded project.</p> <p>Produced by: NSW Department of Primary Industries (Editor: Rowan Fawcett (Citrus Development Officer), Glenn Salmond (Rural Extension Officer), Design, Illustration & Layout: Black Kitty Design (BlackKitty.com.au))</p> <p>Project leader: Dr. Talib Khurshid, Advisor/mentors: Dr. Chanderjit Nishi, Akbar Saeed, Yasmeen Tahir & Waqar Ali. This booklet is based on the "Harvest the Research" booklet produced by the Citrus Growers of South Australia.</p> <p>Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (August 2015). However, because of developments in technology, science and industry, the information contained in this publication may not be up to date. It is the responsibility of the user to ensure that the information is current and relevant to their needs. The user and the publisher accept no responsibility for any loss or damage caused by reliance on the information contained in this document.</p> <p>© Copyright 2015</p>	

PRE RELEASE VERSION



Australian Government
Australian Centre for International Agricultural Research



NSW
Department of Primary Industries



Figure 41. Training manual produced during the project in conjunction with FVDP



Figure 42: Fact sheets produced during the project



Figure 43. FVDP website was used for extension purposes

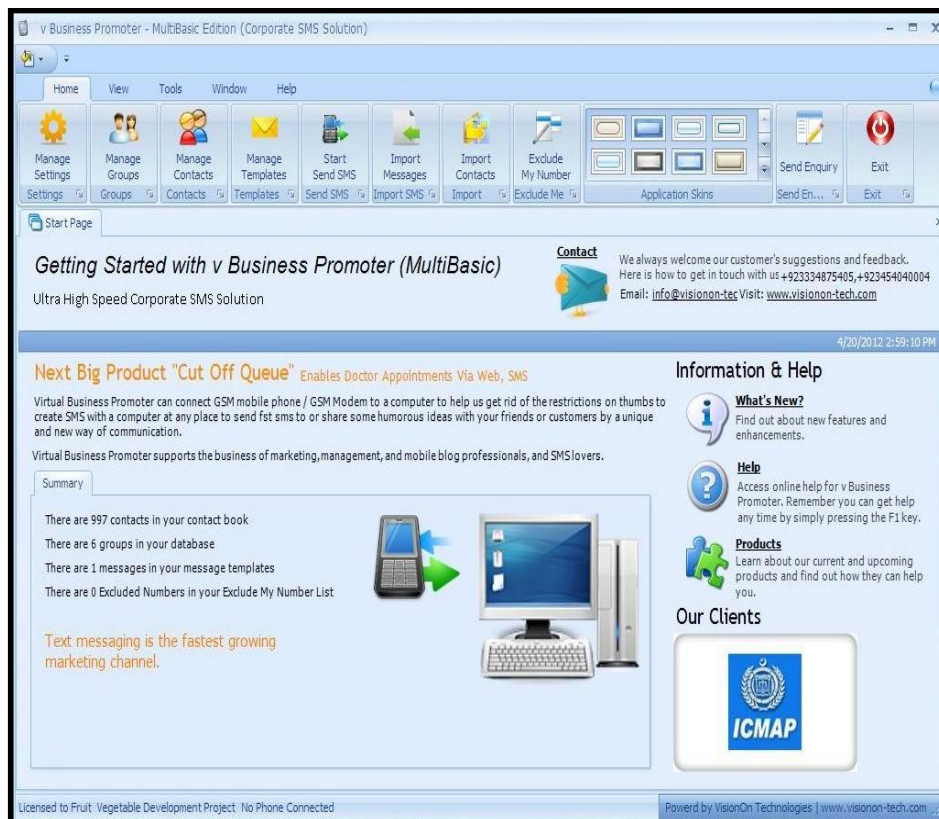


Figure 44. SMS system was used for extension purposes



Figure 45. 9 Newsletters were produced during the project



Figure 46. Fortnightly Farmers Field Schools were held

11 Appendices

11.1 Appendix 1: Australian project team visits to Pakistan

Visit 1: Itinerary for Trip to Pakistan/Thailand 4 - 19 Jan, 2011 Dr Tahir Khurshid	
Date	Location (Country/City)
4 Jan (Tue)	Mildura - Melbourne (QF2087) / 10:05-11:00
4 Jan (Tue)	Melbourne - Bangkok (TG988) / 23:30-4:10 arrives Bangkok on 5 Jan in the morning
5 Jan (Wed)	<p>Bangkok – Chiang Mai (TG102) / 7:50-9:10 am Tahir arrives at Chiang Mai airport at 9:10 am Tahir travels by road from Chiang Mai in morning to Thanathon orchards in Fang (arranged by Mr Koung)</p> <ul style="list-style-type: none"> • Meeting with Mr Koung about the possibility of crop management training for the Pakistan project staff • Inspection of Packing facilities / nursery visit • Inspection of accommodation facilities at Fang for the trainees • Orchard visits <p>Accommodation: Stay at Fang – Hotel accommodation to be booked by Mr Koung and paid by Tahir on arrival.</p>
6 Jan (Wed)	<p>Tahir travels in morning by road from Fang to Chiang Mai city (arranged by Mr Koung) and arrive at the University.</p> <ul style="list-style-type: none"> • Dr Sakesan (Meeting coordinator), Discussions /Inspection of the Labs • PowerPoint Presentation by Tahir Khurshid (Australian Citrus Industry) • Meeting with Prof. Prawit Puddhanon (Dean Faculty of Agriculture) • Meeting with Dr Sahha Toolapong and other available staff members • Visit to a Citrus nursery or fruit nursery in Chiang Mai – arranged by Dr Sakesan <p>Accommodation: Stay in Chiang Mai – Hotel accommodation to be booked by Dr Sakesan and paid by Tahir on arrival.</p>
7 Jan (Fri)	<p>TAHIR departs for Bangkok Chiang Mai-Bangkok (TG117) / 11:30-12:50</p> <p>Accommodation: Stay at Indra Regent</p>
8 Jan (Sat)	<p>Bangkok-Lahore (TG 345) / 11:00-14:15</p> <p>Travel to from the airport to Hotel in armoured car organised by Dr Kazmi (Australian HC) Accommodation: Avari Towers, Lahore</p>
9 Jan (Sun)	<p>Informal meeting with Dr M. Kazmi (ASLP Program Officer) &Hafeez-ur-Rahman (Citrus project co-coordinator)</p> <ul style="list-style-type: none"> • Dr Kazmi and Dr Hafeez thoughts over the trip • Viewing of the Powerpoints/plans • Dr Kazmi is going to organize an irrigation provider other than Jaffer brothers. We should also meet M Anees from Jaffer brothers probably at Sargodha to fix the existing system what we discussed in our May 2010 meeting. <p>Accommodation: Avari Towers Hotel, Lahore.</p>

<p>10 Jan (Mon)</p>	<p>Meeting with Fruit &Vegetable Development Project in Avari Towers Hotel, Lahore</p> <p><u>Morning</u> Meeting with Asif Khan and Mr Khaloon</p> <ul style="list-style-type: none"> • Revision of FFS work plan • Co-ordination of FFS work with our plans • Identification of extension officers for training in Australia (Important) • Identification of growers properties for irrigation • Resource identification for HDP <p>Lunch with FVDP Coordinator</p> <p><u>Afternoon</u></p> <ul style="list-style-type: none"> • Meeting with Secretary Punjab and other delegates in their office • Project progress • Project start Phase 2 • Dinner with the Secretary in evening <p>Accommodation: Avari Towers Hotel.</p>
<p>11 Jan (Tue)</p>	<p><i>Travel to Faisalabad in morning by Road in armoured car organised by Dr Kazmi (Australian HC)</i></p> <p>Meeting with University of Faisalabad (UAF) in the University Campus</p> <ul style="list-style-type: none"> • Meeting with Dr Jaskani • Project plan (we will do this with Dr Jaskani) • Inspection of the screenhouse and mother blocks and germplasm inspection • Current project progress <p>Afternoon:</p> <ul style="list-style-type: none"> • Meet Vice Chancellor (Dr Hafeez is still consulting Jaskani) <p>Accommodation: Stay in Sarina Hotel Sargodha</p>
<p>12 Jan (Wed)</p>	<p><i>Travel to Sargodha in morning by Road in armoured car organised by Dr Kazmi (Australian HC)</i></p> <p>Meeting and inspections at CRI with CRI Sargodha + ARI Tarnab Staff)</p> <ul style="list-style-type: none"> • Inspection of the newly built Screenhouse • Inspection of the irrigation system • Data loggers • Meeting with Roshan enterprises at Roshan enterprise packing shed, along with Tahir Jameel and Mr Cheema • Visit of a local nursery: Going to a nursery is equally important; we need to find a time. <p><i>Travel back to Faisalabad in evening by Road in armoured car organised by Dr Kazmi (Australian HC)</i></p> <p>Accommodation: Stay in Sarina Hotel Sargodha</p>
<p>13 Jan (Thu)</p>	<p>Meetings with CRI, ARI at the University of Faisalabad</p> <ul style="list-style-type: none"> • Meeting for ARI Work plan & Current project progress <p>Combined wrap up meeting with CRI, ARI, UAF and FVDP</p>

	Accommodation: Stay in Sarina Hotel Sargodha
14 Jan (Fri)	<p>Travel back to Islamabad in morning by Road in armoured car organised by Dr Kazmi (Australian HC)</p> <p>Meeting with Dr Iftikhar in his office Meeting with Dr Zafar Altaf (PARC) in his office Meeting with DG (FSC&RD) in his office?</p> <p>Accommodation: Stay in Islamabad has already organized by Dr Kazmi.</p>
15 Jan (Sat)	<p>Meeting with Project staff in NARC</p> <p>Meeting with Dr Hafeez; NARC</p> <ul style="list-style-type: none"> • Current project progress • Inspection of germplasm plants • Inspection of citrus high density plans/site • Annual work plan <p>Lunch Meeting Informal Meeting Dr Zafar Altaf Chairman PARC, Dr Iftikhat Ahmed DG NARC, Dr M Kazmi (Project Officer), Staff from MinFA, Dr Abdul Majid ICARDA, DG FSC&RD and MH Laghari (Lunch NARC Cafeteria). Cafeteria is fine.</p> <p>Project officer Interview at NARC? How many candidates are we interviewing and who is participating in the interview?</p> <p>Accommodation: Stay in Islamabad has already organized by Dr Kazmi.</p>
16 Jan (Sun)	<p>General meeting with Dr Iftikhar, Dr Kazmi and Dr Hafeez; any other issues</p> <ul style="list-style-type: none"> • General comments about the trip and future plans • ICARDA involvement (general discussions) <p>I am not staying in Best Western Hotel; I am staying in a different Place in Islamabad; Please talk to Dr Kazmi.</p> <p>TAHIR'S TRIP CONCLUDES around Lunch time -----</p> <p>Travel report writing for ACIAR/I&I NSW (Tahir)</p> <p>Accommodation: Stay in Islamabad has already organized by Dr Kazmi</p>
17 Jan (Mon)	<p>Departure for Australia Travel to from hotel to the airport in armoured car organised by Dr Kazmi (Australian HC)</p> <p>Tahir Departs for Australia</p> <p>Islamabad to Bangkok (TG 350) 23:35-6:20 (arrives 18/1/11)</p> <p>Accommodation: Stay at Best Western Hotel, Islamabad</p>
19 Jan (Tue)	Bangkok to Melbourne (TG 465) 00:15-13:25 (departs after mid-night)
19 Jan (Wed)	Melbourne to Mildura (QF2084) 15:10-16:20

Visit 2: Itinerary for Trip to Pakistan 21 - 31 Oct; 2011 Dr Tahir Khurshid and Mary Cannard	
Date	Location (Country/City)
21 Oct (Fri)	Citrus workshop at Sareena Faisalabad: Dr Iftikhar will chair the session

	<p>1055: Recitation 11:00-1120:ASLP Citrus project Phase 2 – Brief introduction 11:25-11:50 Australian Citrus Research (Dr Tahir Khurshid) 12:00-12:15 Fruit Thinning Trial results of 'Kinnow' (Dr Tahir Khurshid) 12:15-1230: Presentation from Growers Associations 1315-1430: Lunch & Jumma Prayers 1430-1530: Australian Citrus Industry (Mary Cannard) What is Aus Citrus? How it works and discussions 3:30 pm Presentation on citrus pest/diseases (Mary Cannard) Venue UAF-Refreshment from Serena Participants: Citrus packing house people; citrus growers associations; project officers, VC UAF</p> <p>Accommodation: Stay in Sareena Hotel, Faisalabad</p>
22 Oct (Sat)	<p><i>Travel straight to Sargodha by Road in armoured car organized by the Australian High Commission</i></p> <p>CRI VISIT Training and presentations:</p> <ul style="list-style-type: none"> • Irrigation and Flume training • Training in data collection • Training to research staff in yield estimations • Project progress discussions with ARI staff • Participation of Mr Jawad (4-Brothers) in Australian training (Invite their representative) <p>Accommodation: Stay in Sareena Hotel, Faisalabad</p>
23 Oct (Sun)	<p>Project Team meeting at UAF, Faisalabad</p> <p>Meeting with Dr Jaskani Project collaborators from University of Agriculture, Faisalabad</p> <ul style="list-style-type: none"> • Project plan • Annual work plan • Inspection of the greenhouse and mother blocks and germplasm • Current project progress <p>All day meeting with project collaborators CRI, ARI, NARC, UAF and F&VDP</p> <ul style="list-style-type: none"> • Discussion about mini conference at UAF • Newsletter <p>Accommodation: Stay in Sareena Hotel, Faisalabad</p>
24 Oct (Mon)	<p><i>Travel straight to Sargodha by Road in armoured car organized by the Australian High Commission</i></p> <p><i>Visit of F&VDP Activities (Chak # 83 SB Abadi, Tehsil & District Sagodha)</i></p> <p>Grower: Sohail Ahmed Wariaach</p> <ul style="list-style-type: none"> • Visit of FFS. • Visit of High Density Plantation Trial. • Visit of Canopy Management Trial. <p>Move for Lahore Accommodation: Stay in Pearl Continental Hotel, Lahore</p>
25 Oct (Tue)	<p>Meeting with the Agriculture Secretary, Punjab (Brief courtesy visit) Tahir Khurshid, Mary Cannard, Dr Kazmi, Dr Hafeez</p> <ul style="list-style-type: none"> • Meeting with Secretary Punjab and other delegates • Project progress • Project start Phase 2 <p>Meeting with Fruit &Vegetable Development Project in their office on Davis Rd</p>

	<p>Tahir Khurshid, Mary Cannard, Dr Kazmi, Dr Hafeez</p> <p>Meeting with Asif Khan and staff</p> <ul style="list-style-type: none"> • Revision of FFS work plan • Co-ordination of FFS work with our plans • Identification of extension officers for training in Australia (Important) • Identification of growers properties for irrigation/high density orchards • Resource identification for HDP <p>Mary Cannard goes back to Lahore airport and exits for Australia >> We will stay the night in Lahore</p> <p>Accommodation: Stay in Pearl Continental Hotel, Lahore</p>
26 Oct(Wed)	<p><i>Travel to Sargodha by Road in armoured car organized by the Australian High Commission.</i></p> <p>Meeting project collaborators at CRI, Sargodha</p> <ul style="list-style-type: none"> • Inspection of the newly built Screen house. • Annual work plan • Inspection of the irrigation system • Meeting with Roshan enterprises (budwood for Roshan) <p>Accommodation: Stay in Pearl Continental Hotel, Lahore</p>
27 Oct (Thu)	<p><i>Travel to Islamabad by Road in armoured car organized by the Australian High Commission.</i></p> <p><u>Afternoon:</u> Meeting with Chairman PARC/DG, NARC</p> <ul style="list-style-type: none"> • Meeting with PARC (Chairman); Dr Iftikhar Ahmad • Viewing videos prepared in Pakistan • Dr M Kazmi (Program Officer) <p>Accommodation: Stay in Sareena Hotel, Islamabad</p>
28 Oct (Fri)	<p><u>Morning:</u></p> <ol style="list-style-type: none"> 1. Heat unit mapping presentation (T Khurshid) 2. Climatic effect on tree crops with reference to citrus <p>Meeting with Syed M. Nasir Ali (DG, FSC&RD)</p> <ul style="list-style-type: none"> • Federal Seed Certification & Registration Department <p>Accommodation: Stay in Sareena Hotel, Islamabad</p>
29 Oct (Sat)	<p>NARC Site visit and trial inspection by Tahir and Dr Hafeez</p> <p>Accommodation: Stay in Sareena Hotel, Islamabad</p>
30 Oct (Sun)	<p>Trip report writing</p> <p>Accommodation: Stay in Sareena Hotel, Islamabad</p>

Visit 3: Itinerary for Trip to Pakistan 4 – 14 May, 2012 Dr Tahir Khurshid and Steven Falivene	
Date	Location (Country/City)
4 May (Fri)	<ul style="list-style-type: none"> • Budwood distribution – Dr Hafeez – 9 am • Meet the Agriculture Secretary in Lahore – 2:30 pm • Australia day in Spring – 7 pm Lahore <p>Accommodation: PC Lahore</p>
5 May (Sat)	<i>Travel to Faisalabad in morning</i>

	<ul style="list-style-type: none"> • Climate presentation to staff and students –Dr Tahir Khurshid (UAF) • UAF nursery component (Australian Germplasm) – Dr Jaskani • Discussion with Dr Jaskani about the Citrus Conference and trials • Discussion about the newsletter <p>Accommodation: Serena Hotel, Faisalabad</p>
6 May (Sun)	<p><i>Travel to sites by Road in armoured car organised by the Australian High Commission.</i></p> <p>Irrigation site visit (Morning)</p> <ul style="list-style-type: none"> • visit to the proposed high density/irrigation site at Ilyas Warraich – and an additional site • We may continue some conference discussion/arrangements with Dr Jaskani and whoever is present <p>Accommodation: Serena Hotel, Faisalabad</p>
7 May (Mon)	<p><i>Travel to CRI by Road in armoured car organised by the Australian High Commission.</i></p> <ul style="list-style-type: none"> • Discussions with Mr Alarf-ur-Rehaman and CRI staff about their component and data collection - Tahir • General inspection of trial sites at CRI – Tahir & Steven • Steven will inspect the site for his work and he will need to get equipment for his component/pitt excavation Tahir & Steven • Meeting with the extension team FVDP at CRI – Steven <p>Accommodation: Serena Hotel, Faisalabad</p>
8 May (Tue)	<p><i>Travel to CRI by Road in armoured car organised by the Australian High Commission.</i></p> <p>Soil Solution Tube Installation</p> <ul style="list-style-type: none"> • Training and Installtion of soil solution tubes – Steven and staff • Audio-visual training for field officers (5 officers) <p>Accommodation: Serena Hotel, Faisalabad</p>
9 May (Wed)	<p><i>Travel to Faisalabad by Road in armoured car organised by the Australian High Commission.</i></p> <p>First citrus growers conference, Organised by ACIAR citrus project staff (Participation, presentations, discussions)</p> <p>Project officers meeting – 4 pm</p> <p>Accommodation: Serena Hotel, Faisalabad</p>
10 May (Thu)	<p>First citrus growers conference, Organised by ACIAR citrus project staff (Participation, presentations, discussions)</p> <p>Accommodation: Serena Hotel, Faisalabad</p>
11 May (Fri)	<ul style="list-style-type: none"> • PARS Visit at UAF • Presentation on nutrition in Australia • Discussion on Nutrition workshop – Steven/Jaskani • Discussion on hand thinning/pruning/nutrition/fertigation trials for postgrad involvement – Tahir /Steven/Jaskani • Installation of soil solution Equipment <p>Accommodation: Serena Hotel, Faisalabad</p>
12 May (Sat)	<p>Mega Field day (FVDP) – Starts in morning</p> <ul style="list-style-type: none"> • Fruit thinning presentation to growers/marketers/harvest contarctors – Tahir • Market value of thinning in Australia • Fruit thining demonstration • Nutrition presentation - Steven

	Travel to Islamabad Accommodation: Serena Hotel, Islamabad
13 May (Sun)	<ul style="list-style-type: none"> NARC – New screenhouse – Dr Hafeez – 8:30 am Accommodation: Serena Hotel, Islamabad
14 May (Mon)	<ul style="list-style-type: none"> Meeting Chairman PARC – 9:30 am Climate Presentation - Fatima Jinnah woman University Wrap up meeting – 1:30 Tahir Meeting at 4 pm in Islamabad – 11:30 am Accommodation: Serena Hotel, Islamabad

Visit 4: Itinerary for Trip to Pakistan 8-16 Sept, 2012 Dr Tahir Khurshid and Jeremy Giddings	
Date	Location (Country/City)/Activity
9 Sep (Sun)	Tahir arrives
10 Sep (Mon)	Travel to Sargodha by road using armoured car provided by Australian High Commission <ul style="list-style-type: none"> Inspect drip/sprinkler demonstration site at CRI. Discussion and evaluation with field officers (CRI needs to make sure that the water is available that day for running the system; Jeremy will inspect the system) Fill the storage as a backup so the water is there for us to run the system Inspect flume surface irrigation sites. Training and discussion with field officers Preparation for irrigation workshop (Jeremy will instruct CRI about the preparations on that day) Return to Faisalabad Dr Hafeez ; Organise tensiometers for Sargodha ARI Peshawar team (Ghulam Nabi, Wajid, and Nisar Naeem) should be present at CRI; they need to be invited Tahir will meet with Dr Hafeez (one to one meeting in evening) Accommodation: Serena Hotel, Faisalabad
11 Sep (Tue)	Travel to Sargodha by road using armoured car provided by Australian High Commission <ul style="list-style-type: none"> Inspect possible locations for future pressurised irrigation demonstration sites (Dr Kazmi need to invite Jaffer brothers and 4 Brothers separately at Mr Ilya's site) 4B at 9 am and Jaffer brothers at 11 am; just my suggestions Inspection of fruit thinning trials at growers property (FFS) Conduct irrigation workshop with extension officers at CRI [AFTERNOON] (Asif Khan needs to arrange a few extension officers + extension officers from ATI + other required staff; they should not more than a 20 people in total) Installation of Tiny tag data loggers at CRI Data collection instruction to project officers/collaborators CRI Dr Hafeez will be present at the workshop and Mr Ilya's property etc. ARI Peshawar team (Ghulam Nabi, Wajid, and Nisar Naeem) should be present at Mr Ilya's property Accommodation: Serena Hotel, Faisalabad

12 Sep (Wed)	<p>Jeremy's Lecture to staff and student at UAF Collaborators meeting at UAF – UAF, CRI, ARI, FVDP, NARC (collaborators need to brief about their activities)</p> <ul style="list-style-type: none"> • Dr Hafeez has to be present for the collaborators meeting • ARI Peshawar team can leave for Peshawar after the collaborators meeting <p>Travel to Islamabad Jeremy will leave for Australia in evening Accommodation: Serena Hotel, Islamabad</p>
13 Sep (Thu)	<p>Visit to NARC Screenhouse to inspect trees Meeting with Dr Iftikhar Ahmad (FAO) - NARC Wrap up meeting with Visit Dr Azeem Khan/Dr Hafeez/Dr Kazmi at NARC</p> <p>Meeting with Coffey International – Ms Erum Rabbani (afternoon – Dr Kazmi need to arrange this) Accommodation: Serena Hotel, Islamabad</p>
14 Sep (Fri)	<p>Report writing/travel day Tahir Depart the same day</p>

Visit 5: Itinerary for Trip to Pakistan 12 Feb – 3 Mar, 2013 Dr Tahir Khurshid and Steven Falivene	
Date	Project activity/venue/city
11 Feb (Mon)	Mildura-Melbourne (QF2077) 6:35-7:40 TRAVEL
14 Feb (Thu)	Melbourne-Bangkok (TG 462) 12:30-5:40 TRAVEL
14 Feb (Thu)	Bangkok-Lahore (TG 345) 19:35-22:50 TRAVEL
	Stay: Pearl Continental, Lahore
15 Feb (Fri)	<p>Travel to Hotel by road using armoured car provided by Australian High Commission</p> <ul style="list-style-type: none"> • Meeting New Secretary Punjab, Lahore – Tahir/Dr Kazmi presents • Meeting FVDP Asif Khan – discussion REVIEW/ mega field day/preparations • Visit Fruit markets in Lahore and meet exporters– FVDP to organise • Metro meeting with Adeel/Sagar 4 pm (Dr Kazmi has arranged) <p>Stay: Pearl Continental, Lahore</p>
16 Feb (Sat)	<p>Travel to Sargodha by road using armoured car provided by Australian High Commission</p> <ul style="list-style-type: none"> • CRI visit – plan for harvest of furrow irrigation, pressurised irrigation, pruning trials (Steven/Tahir/CRI staff) • General business with CRI/review preparation • Posters – external Review in suitable venue Islamabad/UAF or CRI) <p>Stay: Serena Hotel, Faisalabad</p>
17 Feb (Sun)	<p>Stay at Hotel in Faisalabad</p> <ul style="list-style-type: none"> • Work with project officers – video, brochures, gross margins, posters • Met station discussion with PO officers • Any other business <p>Stay: Serena Hotel, Faisalabad</p>
18 Feb (Mon)	<p>Travel to Sargodha by road using armoured car provided by Australian High Commission</p> <ul style="list-style-type: none"> • Australian harvest practices demonstration and discussion on optimum

	<p>harvest practices in Pakistan (packers, contractors, extension officers and research officers need to be there) Dr Hafeez please arrange 4 contractors, 2-3 packing house officers, 1-2 whole sellers/export officers plus CRI staff and us collaborators. Ask contractors to bring the equipment (baskets, knives etc.) used for harvest to conduct Pakistan harvest demonstration. It will be an informal small harvest practical demonstration and discussions. Can you please organise it and invite people.</p> <ul style="list-style-type: none"> • Commence harvest at CRI experimental trials (involvement of extension officer) ARI Staff Nisar/Ghulam Nabi/Wajid has to present • General visit Bhlawal Markets in afternoon (Dr Hafeez to arrange with Chairman of markets for market inspection and to arrange meeting with 2 wholesalers) <p>Stay: Serena Hotel, Faisalabad</p>
19 Feb (Tue)	<p>Travel to Sargodha by road using armoured car provided by Australian High Commission</p> <p>>>> Continuation of trial harvest</p> <p>Nursery day at CRI Sargodha</p> <ul style="list-style-type: none"> • Presentation by Australian trained citrus nurserymen to invited nurserymen (Latif-ur-Raheem, Dr Daud, Afzaal, Shaukat) • Demonstration of Chip budding by nurserymen • Media preparation by Faisal/Inam (Mango project Linkages) • Lunch for participants organised by Itaf-ur Rehman (Director CRI) and paid by Tahir <p>(Nurserymen need to be invited Dr Jaskani/Dr Hafeez) Dr Hafeez to arrange 20 nursery trees and budwood for Chip budding practice)</p> <p>ARI Staff Nisar/Ghulam Nabi/Wajid has to present; Latif Raheem/Dr Dauood/Afzaal, Shoukat has to be present for presentation</p> <p>Stay: Serena Hotel, Faisalabad</p>
20 Feb (Wed)	<p>Travel to TTSINGH by road using armoured car provided by Australian High Commission</p> <ul style="list-style-type: none"> • Mega field day TT SINGH(Pruning/Phenology/A Bearing) – URDU phenology poster distribution – (FVD project to organise) • Quality payment system forum (4 contractor, growers, 2 packing people, collaborators, 2 whole sale) FVD project to organise • Visit packing shed to conduct packing audit/survey, Dr Hafeez to organise a packing shed visit (not Roshan enterprise) <p>Stay: Serena Hotel, Faisalabad</p>
21 Feb (Thu)	<p>University of Faisalabad</p> <p>Collaborations Meeting/review/next year planning (draft Agenda will be attached)</p> <p>Chair: Dr Tahir Khurshid/Dr Iftikhar Ahmad</p> <ul style="list-style-type: none"> - Collaborators should follow the attached document and prepared in advance before coming to the meeting) - Coordinator's role/Project officers role - Next year project planning + sociology group (Dr Azeem/others) - Internal Project review - Project Review (April/May) <p>All collaborators have to be present</p> <p>Stay: Serena Hotel, Faisalabad</p>
22 Feb (Fri)	<p>University of Faisalabad</p>

	<ul style="list-style-type: none"> • Nutrition presentation by Steven at UAF staff and students (Dr Jaskani to organise) • Pruning/reworking demonstration for project officers and interested students – (Dr Jaskani to organise trees) • Meeting with project officers with SF/TK • Work with project officers – video, brochures, gross margins, posters <p>ARI Staff Nisar, Ghulam Nabi, can join</p> <p>Stay: Serena Hotel, Faisalabad</p>
23 Feb (sat)	<p>Travel to Sargodha by road using armoured car provided by Australian High Commission</p> <ul style="list-style-type: none"> • Commence harvest at Mr Ilya's property [FVDP staff as per Asif Khan instructions has to be present] • Inspection of furrow trial • Inspection of pressurised irrigation trial / Meeting with B4 representative (Tauseef has to arrange with 4B representative to present) • Discuss preparation for review and Steven discussion with Wajid and Tauseef <p>Travel to Islamabad in late afternoon</p> <p>Stay: Serena Hotel, Islamabad</p>
24 Feb (Sun)	I and Steve are keeping a spare day for some other project activities
25 Feb (Mon)	<p>9:30 am - Visit with UNIDO Serena Complex 9:30 am 10:30-11:45 am - Visit CABI</p> <p>1:00 pm - Chairman PARC (Dr Iftikhar Ahmad)/Dr Sahazia/Dr Azeem/Dr Hafeez/Dr Tahir/Steven/Dr Kazmi/Kate Chamley (Aus Aid)/Dr Majeed (ICARDA) - wrap up meeting and Lunch [Venue: Serene Hotel] if I missed some on , please let me know</p> <p>Stay: Serena Hotel Islamabad</p>
26 Feb (Tue)	<p>Visit Dr Hafeez NARC trials TV Interview - NARC</p> <p>Stay: Serena Hotel Islamabad</p>
27 Feb (Wed)	<p>Australian team Travel report writing</p> <p>Depart for Bangkok</p> <p>Stay: Serena Hotel Islamabad</p>
28 Feb (Thu)	<ul style="list-style-type: none"> • Arrive in Bangkok and proceed to transfer Desk <p>Bangkok-Chiang Mai (TG 102) 8:00-9:20 (received by Pui and Jaa)</p> <ul style="list-style-type: none"> • Travel to Fang by road (2.5 hours drive) • Lunch at Fang • Inspection of Orchards and advise by SF/TK (Meet Mr Bintoon and Staff)/Inspection training facilities <p>Stay: Tangerine Hotel, Fang</p>
1 March (Fri)	<ul style="list-style-type: none"> • General discussions/Thanathon Orchards • Rootstock presentation • Travel Fang to Chiang Mai by Road • Visit MaeJo University, Chiang Mai/ Tahir Presentation to staff/postgrads <p>Stay: Suriwong Hotel, Chiang Mai</p>
2 Mar (Sat)	Chiang Mai-Bangkok (TG 103) 10:10-11:30
3 Mar (Sun)	Bangkok-Perth (TG 481) 7:45-15:40

6 Mar (Wed)	Perth-Melbourne (QF 802)) 10:50-17:25 Melbourne-Mildura (QF 2086) 18:50-19:55
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Visit 6: Itinerary for Trip to Pakistan 13 April – 22 April, 2013 Dr Tahir Khurshid	
Date	Project activity/venue/city
14 Apr (Sun)	Mildura-Melbourne (QF2085) 16:40-18:00 TRAVEL
14 Apr (Sun)	Melbourne-Bangkok (TG 462) 23:30-6:00 (arrives 15 Apr)
15 Apr (Mon)	Bangkok-Islamabad (TG 349) 19:00-22:10 TRAVEL Stay: Serena Hotel, Islamabad
16 Apr (Tue)	Travel to PARC by road using armoured car provided by Australian High Commission <ul style="list-style-type: none"> • Meeting Chairman PARC/Project progress • Visit greenhouse and inspect field trials at NARC • Arrange trial site for mid-term review Stay: Serena Hotel Islamabad
17 Apr (Wed)	Travel to PARC by road using armoured car provided by Australian High Commission <ul style="list-style-type: none"> • Meeting Nurserymen/growers • Presentation from Nurserymen • Arrange nursery site for mid-term review Stay: Serena Hotel, Islamabad
18 Apr (Thu)	Travel to NARC by road using armoured car provided by Australian High Commission <ul style="list-style-type: none"> • Meeting with collaborators • Presentation practice runs • Arrange poster session Stay: Serena Hotel, Islamabad
19 Apr (Fri)	Travel to NARC by road using armoured car provided by Australian High Commission <ul style="list-style-type: none"> • Mid-term review presentations • NARC field trip Stay: Serena Hotel Islamabad
20 Apr (Sat)	Travel to Faisalabad by road using armoured car provided by Australian High Commission <ul style="list-style-type: none"> • Meet Vice Chancellor, University of Faisalabad (UAF) • Nursery component at UAF • Visit grower's property in Sargodha) • Visit and inspect CRI facilities and research trials • Travel to Lahore • Leave for Bangkok at night
20 Apr (Sat)	Lahore-Bangkok (TG 346) 23:40-6:10 (arrives 21 Apr)
22 Apr (Mon)	Bangkok-Melbourne (TG 465) 00:15-12:05
22 Apr (Mon)	Melbourne-Mildura (QF 2084) 15:15-16:20

Visit 7: Itinerary for Trip to Pakistan 30 Sep – 13 Oct, 2013 Dr Tahir Khurshid, Dr Nerida Donovan, Jason Bowes, Steven Falivene	
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Date	Project activity/venue/city
30 Oct (Mon)	Mildura-Sydney
1 Oct (Tue)	Sydney - Bangkok
2 Oct (Wed)	Bangkok-Islamabad (arrive at night time) Stay: Serena Hotel Islamabad
3 Oct (Thu)	Travel to NARC <ul style="list-style-type: none"> • Preparation at NARC for training (invite from KP also especially ladies from Hari pur) -Inspection of screenhouse Stay: Serena Hotel Islamabad
4 Oct (Fri)	<ul style="list-style-type: none"> • Nursery training at NARC – Full day training - 15 Nurserymen (KP), 2 budders from ATI, Tarnab [Nisar Naeem/Wajid to arrange] - 2 budders who work for Dr Hafeez [Dr Hafeez to arrange] - Only Dr Daud Rehman from Haripur [Dr Hafeez to invite] - 5-7 Ladies from Haripur [Dr Kazmi to arrange] - Invitation to social team [Tahir has to invite] - Invitation to Mango coordinator/project officer [Tahir Has to invite] - Invitation to Inam [Tahir has to invite] - Video shooting [Steven and Wajid] Stay: Serena Hotel Islamabad
5 Oct (Sat)	Travel to Sargodha by road using armoured car provided by Australian High Commission <ul style="list-style-type: none"> • Training at ATI with budders/CRI budders/Nurserymen from Sargodha (1/2 day) <ul style="list-style-type: none"> • Brief visit to CRI • Visit to a new Demo site with Asif Khan/B4 guy need to accompany - Training at ATI – [Dr Kazmi to arrange] - 20 Nurserymen from Sargodha [Abdul Rehman and Afzal] New nurserymen not the one who have already been trained in Feb 2013. - 3 Budders from CRI [Abdul Rehman] - ATI instructors needs to participate [Dr Kazmi to arrange] Stay: Serena Hotel, Faisalabad
6 Oct (Sun)	Travel to Sargodha by road using armoured car provided by Australian High Commission <ul style="list-style-type: none"> • Brief visit to Mr Ilyas's property for irrigation inspection/B4 guy need to be present • Afzal Nursery on the way from Islamabad than to CRI • Preparation for nursery training at UAF • Dinner invitees (Dr Jaskani/Dr Iqrar etc) Invite Dr Iqrar Khan to have dinner with Dr Tahir, Dr Nerida Donovan, Jason Bowes and other staff (we can nominate that later) – Dr Jaskani has to arrange Dr Iqrar invitation Stay: Serena Hotel, Faisalabad
7 Oct (Mon)	<ul style="list-style-type: none"> • Nursery training • Deliver training at UAF (Female students) • Nurserymen TT Singh • Lunch for trainees/logistics • - 15 Nurserymen Faisalabad area [Dr Jaskani Tuseef to arrange] - 15 Nurserymen TT Singh [Asif Khan to arrange] - Female students who works in nursery component [Dr Jaskani to arrange] Stay: Serena Hotel, Faisalabad
8 Oct (Tue)	Training on Reworking at UAF orchard <ul style="list-style-type: none"> • Check out from Serena Faisalabad • UAF reworking (VC) – Jason • Uni Budders – possibility of 10 to 20 trees (demo site)

	<ul style="list-style-type: none"> • Dr Nerida Donovan Lecture [Dr Jaskani to arrange] • Travel to Lahore and stay <p>This day is allocated for the reworking training at UAF, It will be nice to select some healthy trees [Tauseef has to arrange White paint, saw to cut tree limbs,</p> <ul style="list-style-type: none"> - Participants local growers [Dr Jaskani to arrange] - Participants, growers from TT Singh [Asif Khan to arrange] - Arrange some budwood for reworking [Dr Jaskani] <p>Stay: Awari hotel Lahore</p>
9 Oct (Wed)	<p>Pattoki Nursery Training</p> <ul style="list-style-type: none"> • General Nursery training <p>Stay: Awari hotel Lahore</p>
10 Oct (Thu)	<ul style="list-style-type: none"> • Wrap up meeting • Meeting with Agricultural secretary <p>Stay: Awari hotel Lahore</p>
11 Oct (Fri)	Arrive in Bangkok
12 Oct (Sat)	Bangkok-Melbourne
13 Oct (Sun)	Melbourne/Mildura

Visit 8: itinerary for Trip to Pakistan Steven Falivene, Tahir Khurshid, Nerida Donovan 28 Jan – 27 Feb, 2014	
Date	Project activity/venue/city
28 Jan (Tue)	<p>Travel to Faisalabad Meet with project officers and plan trial harvest Steven and project officers will conduct the harvest/Asif Khan need to be involved Stay: Serena Hotel Faisalabad</p>
29 Jan (Wed)	<ul style="list-style-type: none"> • Harvest and marketing of Mr Ilya's quality payment site Steven and project officers will conduct the harvest/Asif Khan need to be involved Stay: Serena Hotel Faisalabad
30 Jan (Thu)	<ul style="list-style-type: none"> • Harvest and marketing of Mr Ilya's quality payment site Steven and project officers will conduct the harvest/Asif Khan need to be involved Stay: Serena Hotel Faisalabad
31 Jan (Fri)	<ul style="list-style-type: none"> • Harvest and marketing of Mr Ilya's quality payment site Steven and project officers will conduct the harvest/Asif Khan need to be involved Stay: Serena Hotel Faisalabad
1 Feb (Sat)	<ul style="list-style-type: none"> • Harvest and marketing of 2nd quality payment site Steven and project officers will conduct the harvest/Asif Khan need to be involved Stay: Serena Hotel Faisalabad
2 Feb (Sun)	<ul style="list-style-type: none"> • Harvest and marketing of 2nd quality payment site Steven and project officers will conduct the harvest/Asif Khan need to be involved Stay: Serena Hotel Faisalabad
3 Feb (Mon)	<ul style="list-style-type: none"> • Export harvest and development Forum - Field demonstration and export harvest practices CRI Orchards - Export harvest, packing, exporting (problems, challenges and opportunities) at ATI Sargodha - Lunch at ATI Sargodha - Steven will conduct this training at CRI, exporters need to be invited. - Abdur Rehman to arrange Lunch as last time. - Dr Kazmi will talk to PHDEC <p>Stay: Serena Hotel Faisalabad</p>
4 Feb (Tue)	<ul style="list-style-type: none"> • Harvest UAF fruit thinning trial Steven and project officers will conduct the harvest Involve a PhD student Ms Nergis – Dr Jaskani has to organise her

	<p>Dr Jaskani needs to be involved Stay: Serena Hotel Faisalabad</p>
5 Feb (Wed)	<ul style="list-style-type: none"> Harvest UAF pruning trial <p>Steven and project officers will conduct the harvest Dr Jaskani need to be involved Stay: Serena Hotel Faisalabad</p>
6 Feb (Thu)	<ul style="list-style-type: none"> Shoot pruning videos UAF or Sargodha <p>Steven and project officers Stay: Serena Hotel Faisalabad</p>
7 Feb (Fri)	<ul style="list-style-type: none"> Shoot pruning videos UAF or Sargodha <p>Steven and project officers Stay: Serena Hotel Faisalabad</p>
8 Feb (Sat)	<ul style="list-style-type: none"> Writing publications with project officers <p>Steven tasks and activities Stay: Serena Hotel Faisalabad</p>
9 Feb (Sun)	<ul style="list-style-type: none"> Writing publications/videos with project officers <p>Steven tasks and activities Stay: Serena Hotel Faisalabad</p>
10 Feb (Mon)	<ul style="list-style-type: none"> Writing publications/videos with project officers <p>Steven tasks and activities Stay: Serena Hotel Faisalabad</p>
11 Feb (Tue)	<p><u>Tahir and Nerida arrives and join the team</u></p> <ul style="list-style-type: none"> Project work update with Nerida, Tahir and project officers, inspect UAF orchards <p>Stay: Serena Hotel Faisalabad</p>
12 Feb (Wed)	<ul style="list-style-type: none"> Harvest trial sites at CRI <p>Dr Hafeez travels to Sargodha to attend the Planning meeting - Abdul Rahman to arrange lunch for us Stay: Serena Hotel Faisalabad</p>
13 Feb (Thu)	<ul style="list-style-type: none"> Project planning meeting UAF <p>All collaborators project officers to attend to attend, including Guulam Nabi from KP Formal invitations to Dr Iftikhar, Dr Shazia and Dr Azeem needs to be given by Dr Hafeez. Dr Kazmi: please arrange the accommodation for Dr Iftikhar, Dr Shazia and Dr Azeem once finalised. Stay: Serena Hotel Faisalabad</p>
14 Feb (Fri)	<ul style="list-style-type: none"> Sargodha Nursery, packing house visits <p>Visit and audit of packing house Dr Hafeez accompanies us Stay: Serena Hotel Faisalabad</p>
15-22 Feb	<p>Steven leaves for Bhutan Tahir and Nerida leaves for Laos for Greening disease trip</p>
18 Feb (Tue)	<p>Arrival of Citrus collaborators to Islamabad to participate in Annual review The participants involved in the review will arrive to Islamabad a night before</p>
19 Feb (Wed)	<p>Annual Review Meeting – Citrus project collaborators from Pakistan will have to make a 20 minute presentation</p> <ul style="list-style-type: none"> Pakistan collaborator 1 Pakistan collaborator 2 Pakistan collaborator 3 <p>This presentation will be similar to the one you guys presented during the review and I can discuss it with you on 13 Feb during project planning meeting</p>
20 Feb (Thu)	<p>Provincial Meeting</p>
22 Feb (Sat)	<p>Dr Tahir and Dr Nerida arrives back Islamabad</p>
23 Feb (Sun)	<p>Dr Tahir and Dr Nerida prepare for meeting and trip report writing</p>
24 Feb (Mon)	<p>Arranged by social science team 4 Citrus meeting participants travel to Bourbon to participate in Social project</p>

	<p>meeting/workshop</p> <ol style="list-style-type: none"> 1. Dr Tahir Khurshid 2. Dr Nerida Donovan 3. Two participants from Pakistan <p>I have spoken to Ms Barbara Chambers and the participating collaborators will be informed by the social team</p> <p>Stay: Bourbon , Muree Hills</p>
25 Feb (Tue)	<p>Arranged by social science team</p> <p>Social Project meeting</p> <p>Social meeting continues...</p> <p>Stay: Bourbon, Muree Hills</p>
26 Feb (Wed)	<p>Arranged by social science team</p> <p>Social Project meeting/workshop</p> <p>Social meeting continues...</p> <p>Stay: Bourbon</p>
27 Feb (Thu)	<p>All participants travel back to Islamabad</p>

<p align="center">Visit 9: Ag Capability Irrigation Training in Pakistan 5-13 Apr, 2014 Dr Tahir Khurshid and Jeremy Giddings</p>		
Date	Location (Country/City)/Activity	Responsibility
5 April (Sat)	Overnight Avari. Lahore	
6 April (Sun)	<p>Ilya's & Atif Property-Visit</p> <p>Prepare for extension workshop(could some photo be sent to Tauseef to get the pit dig)</p> <p>Stay: Serena Hotel, Faisalabad</p>	Tauseef to arrange
7 April (Mon)	<p>Growers workshop-morning</p> <p>Extension officer workshop-afternoon</p> <p>Serena Hotel, Faisalabad</p>	Tauseef/Asif Khan/Jaskani
8 April (Tues)	<p>Leave early morning</p> <p>Prepare extension workshop</p> <p>Stay: Ramada Hotel, Multan</p>	Asif/Dr Nazim
9 April (Wed)	<p>Extension officer workshop (BZU) - am</p> <p>Growers workshop-afternoon - pm</p> <p>Combined mango/citrus officers</p> <p>Dinner for Participants</p> <p>Stay: Ramada Hotel, Multan</p>	Asif/Dr Nazim- to identify growers
10 April (Thu)	Earlier visit to Citrus/Mango Orchards	Asif/Dr Nazim- to arrange visit
11 April (Fri)	<p>Prepare for extension workshop am</p> <p>Deliver growers workshop pm</p> <p>Stay: Asim Frams</p>	Gul Bahar/Yousaf Channa- to identify growers
12 April (Sat)	<p>Morning: Deliver extension officer workshop (Sindh Agriculture University-SAU)</p> <p>Stay: Karachi</p>	Gul Bahar/Yousaf Channa- to identify
13 April (Sun)	<p>Karachi-Bangkok 23:50 (TG 508)</p> <p>Departure Back</p>	

<p align="center">Visit 10: ASLP Citrus Crop management & Value Chain Improvement Project 3-18 Jan, 2015 Dr Tahir Khurshid, Steven Falivene and Gerard McEvelly</p>	
Date	Project activity/venue/city
3 Jan (Sat)	Travel from Australia to Pakistan (Lahore)

	Mildura-Melbourne 10:05-11:10(QF 2079) Melbourne – Bangkok 00:30 – 5:40 (TG 462)
4 Jan (Sun)	Bangkok-Lahore – 11:00 -14:15 (TG 345)
5 Jan (Mon)	<ul style="list-style-type: none"> Meeting with Secretary Agriculture Punjab (Dr Hafeez to organise) Project Progress Scoping study – Value chain project Travel to Faisalabad
6 Jan (Tues)	<p>Visit of CRI Sargodha</p> <ul style="list-style-type: none"> Harvest trials – pruning, irrigation, best management (CRI staff/Tauseef to organise) Harvest operations at Ilya’s property – SB 83 Sargodha (Tauseef to organise)
7 Jan (Wed)	<ul style="list-style-type: none"> Best practice site visit (Hamad Tarar) 4 SB Bhalwal, Sargodha Malik Atif Awan, Sargodha (Asif Kan to arrange); Chak Number 47 Sargodha Consumer focus groups (Two - one each for males and females - at UAF) – Taussef and Sohail to organise in our absence
8 Jan (Thu)	<ul style="list-style-type: none"> Packing shed and scoping study – (Farhad Jan), Ajnala Rd 20 Chak, Bhalwal Packing shed and scoping study – Roshan Enterprises (Khalid Ejaz Qureshi, Cell: 0300-8460092) Kot Momin Road, Bhalwal
9 Jan (Fri)	<ul style="list-style-type: none"> Packing shed and scoping study – Iftikhar Ahmad & Co. (Waheed Ahmad, Cell: 0321-8272772); Sargodha Road, Bhalwal 'Kinnow' Industry Forum (Same Venue) Invitations and arrangements (Sohail/Tauseef) Thailand nursery trainees from KP arrives (Dinner at Serena – Tahir to arrange dinner)
10 Jan (Sat)	<p>Collaborators Meeting - (Project progress/scoping study/Nursery) – Chair by Tahir Khurshid) – 10 am start</p> <ul style="list-style-type: none"> Collaborators/Researchers/growers Nursery trainees <p>We are planning to invite nursery trainees (discussions Tahir/Nisar/Dr Jaskani) Dr Jaskani to arrange tea/Lunch for collaborators meeting Tauseef has to arrange a banner for Annual planning meeting</p>
11 Jan (Sun)	Travel to Islamabad
12 Jan (Mon)	<ul style="list-style-type: none"> Meeting with Federal Secretary/Dr Iftikhar Ahmad (Chairman PARC)/ Dr Azeem Khan (DG NARC) [Project briefing and future projects by Tahir Khurshid to Federal Secretary] – Dr Hafeez to arrange Website staff Meeting (Steven and Tahir in afternoon)
13 Jan (Tue)	<p>Islamabad – Dubai 9:00 – 11:35 (EK 613)</p> <p>Accommodation: Avari Dubai (E: reservations@avari-dubai.ae)</p>
14 Jan (Wed)	<p>Check markets and fruit condition in Dubai</p> <p>FUCOM. LLC. IBN Battuta Mall, Sheikh Zayed Street. (Mr Muhammad Ali)</p> <p>Cell: + 971 55 300 3653/ + 97150 4671700</p> <p>Accommodation: Avari Dubai</p>
15 Jan (Thur)	<p>Dubai - Jakarta 10:45 – 22: 08 (EK 358)</p> <p>Accommodation: Holiday Inn, Kemayoran (Ph: +62 21 2956 8800)</p>
16 Jan (Fri)	<p>Check markets and fruit condition in Jakarta</p> <p>JL. PARANG TRITIS RAYA NO.3 ANCOL BARAT-UTARA. (Hanny).</p> <p>Cell: +628118770829</p> <p>Accommodation: Holiday Inn, Kemayoran</p>
17 Jan (Sat)	<p>Fly out to Melbourne</p> <p>Jakarta – Singapore 17:15 – 19:55 (EK 7780)</p> <p>Singapore – Melbourne 22:25 – 8:50 (EK 404)</p>
18 Jan (Sun)	Melbourne to Mildura 15:15 -16:20 (QF 2082)

Visit 11: End of project review September 2015- Pakistan 1-13 Sep, 2015 Dr Tahir Khurshid and Steven Falivene		
Date	Location (Country/City)/	Activity
5 Sep (Sat)		<ul style="list-style-type: none"> • Collaborators/preparations/discussions Accommodation: Serena Hotel Islamabad
6 Sep (Sun)		<ul style="list-style-type: none"> • Australian team meeting with reviewers at the hotel/possible dinner meeting Accommodation: Serena Hotel Islamabad
7 Sep (Mon)		<ul style="list-style-type: none"> • Show case event/launching training packages and nursery manual at NARC (Invitations to Minister, Seerat Sahib, Dr Iftikhar, Dr Azeem, Nurserymen and others...KP team • Tahir Presentation • Releasing packages • Steven talk about Quality payment system Accommodation: Serena Hotel Islamabad
8 Sep (Tue)		<ul style="list-style-type: none"> • 9 AM - Presentation from NARC – Dr Hafeez Germplasm/nursery development • 10 AM - Presentations from KP – TBA Nursery management, Crop management, irrigation, Quality payment (Nisar and Wajid) • 11am - Inspecting NARC screenhouse (scion and rootstock mother block site visit) Lunch 12:30pm 2 pm Travel to Faisalabad in afternoon Accommodation: Serena Hotel Faisalabad
9 Sep (Wed)		<u>Full day (field activities)</u> <ul style="list-style-type: none"> • Visit to Mr Zubair's property (short visit) • Visit to Ilya's property (<i>few selected members like those involved in quality payment system; pack house owner, traders</i>) • CRI – Trials, screenhouse, irrigation • Afzaal Nursery – Tahir has to ring Afzaal Accommodation: Serena Hotel Islamabad
10 Sep (Thu)		<ul style="list-style-type: none"> • 9 am Dr Jaskani work, postgrads. Newsletters, Posters, publications Germplasm, nursery component • 10 am Presentation from CRI Nursery, crop management, irrigation, Tauseef QPS, Razza irrigation • 11 am Presentation from FVDP – Asif Khan (extension and growers sites) • Lunch 12:30 – Accommodation: Serena Hotel Islamabad
11 Sep (Fri)	Lahore-Bangkok	23:40 -6:10 (TG 346) <i>arrive Sat in Bangkok</i>
13 Sep (Sun)	Bangkok-Melbourne	00:15 -12:00 (TG 465)
	Melbourne-Mildura	15:15 -16:20 (QF 2082)

11.2 Appendix 2: Pakistan collaboratos visits to Australia

Visit 1: Training program for Wajid Ali and Tauseef Tahir 20 Aug – 3 Sep, 2012	
Date	Location (Country/City)/Activity
20 Aug (Mon)	Islamabad – Bangkok (TG 350) 23:30 - 6:25 (arriving 21 Aug)
21 Aug (Tue)	Bangkok - Melbourne (TG465) 8:00-20:00 Tahir will meet the officers at Melbourne International airport Accommodation: Ibis Hotel city centre, Melbourne
22 Aug (Wed)	Melbourne-Mildura (QF 2078) 8:35-9:40 Travel to Dareton <ul style="list-style-type: none"> • Meet staff at Dareton / Station research visit - Tahir • Orchard visit Michael Keenan • Check-in-Hotel Accommodation: Aquarius Apartments, Mildura
23 Aug (Thu)	Travel to Dareton <ul style="list-style-type: none"> • Pruning training – Steven and Tahir • Practical Pruning exercises – Wajid and Tauseef and Steven • Pruning Video Preparation • Brochure making for Fruit thinning – Tahir and Steven • Brochure making for Pruning – Tahir and Steven • Farm budgets Accommodation: Aquarius Apartments, Mildura
24/8/12 (Fri)	Travel to Dareton <ul style="list-style-type: none"> • Phenology data, importance and data collection – Tahir presentation • In field methodology of data collection • Juicing and measuring quality variables – Tahir Fruit grading – Tahir • Lunch • Reworking/budding practices – Graeme Sanderson (1/2 day) Accommodation: Aquarius Apartments, Mildura
25 Aug (Sat)	Travel to Dareton <ul style="list-style-type: none"> • Video Editing of pruning video • Bunnings and other shops – Steven Accommodation: Aquarius Apartments, Mildura
26/8/12 (Sun)	<ul style="list-style-type: none"> • Discussion on forum for farmer payment system at Apartments. Accommodation: Aquarius Apartments, Mildura
27 Aug (Mon)	Training in fruit harvesting – Steven <ul style="list-style-type: none"> • Visit to Nurseries – Bob Jolly – Tahir and Steven • Jason’s nursery – Tahir and Steven • Grower property visit at Seven fields Accommodation: Aquarius Apartments, Mildura
28 Aug (Tue)	Irrigation training – Jeremy Giddings <ul style="list-style-type: none"> • Installation of Tensiometers - Jeremy • Drip irrigation, pressure checking, cleaning the system – Jeremy • Flume data processing – Jeremy Accommodation: Aquarius Apartments, Mildura
29 Aug (Wed)	<ul style="list-style-type: none"> • Train Officer in installation of data loggers/tiny tags/soil probes - Tahir • Visit MFC - Tahir and Mara

	<ul style="list-style-type: none"> • Simmonetta (audit training) Accommodation: Aquarius Apartments, Mildura
30 Aug (Thu)	<ul style="list-style-type: none"> • Brochure making continues..... • Farm budgets • Packing shed audits - Desktop discussion Accommodation: Aquarius Apartments, Mildura
31 Aug (Fri)	<ul style="list-style-type: none"> • Leaf sampling for nutrition analysis - Steven • Soil solution installation and lab analysis • Continue Brochure and budgets Accommodation: Aquarius Apartments, Mildura
1 Sep (Sat)	<ul style="list-style-type: none"> • Project work meeting - reviewing work plans Accommodation: Aquarius Apartments, Mildura
2 Sep (Sun)	Check-out from the Hotel 8:40 am - Travel to Mildura airport Mildura – Melbourne (QF 2079) 10:05 – 11:10 Melbourne – Bangkok (TG 462) 23:30-6:00 (arriving 3 Sep)
3 Sep (Mon)	Bangkok – Islamabad (TG 349) 19:00 – 22:10

Visit 2: Training program for Nurserymen Nov, 2012		
Date	Activity	Details
1 Nov (Thu)	Participants arrive in Australia	4 citrus participants / 4 mango participants Arrive Sydney EK412 7.00 am and TG475 7.40 am Participants met at airport by Ian Bally and escorted to Campbelltown Travel from airport to Rydges Campbell town by ACE shuttle services Ph 02 46531150 (Return airport run \$299) – meet at McDonalds, international terminal at 9.30 am Accommodation at Rydges, Campbelltown NSW (\$169 / room / night) http://www.rydges.com/campbelltown Sustenance money given to participants by Ian Bally
2 Nov (Fri)	Welcome and training workshop	Workshop to be held at Elizabeth Macarthur Agricultural Institute – see detailed agenda for day Maxicab transport between Rydges and EMAI – pickup Rydges 8.15 am Lunch – pickup 12.00, Argyle Gourmet \$156 Welcome dinner – Infusion Restaurant, Rydges Campbelltown 6.00 pm
3 Nov (Sat)	Participants travel to training venues	Participants travel Rydges Campbelltown to Sydney airport by ACE shuttle services Citrus participants travel Sydney to Mildura by air QF421 dep Sydney 9.30 arr Melbourne 11.05 QF2082 dep Melbourne 13.50 arr Mildura 15.05 Participants met at Sydney airport by ASLP Citrus Project Leader Tahir Khurshid and accompanied to Mildura Accommodation: Aquarius Apartments 832 15th street Mildura VIC http://www.aquariusapartments.com.au Mango participants travel Sydney to Brisbane by air: QF 512 dep Sydney 9.05 arr Brisbane 9.35 am Travel Brisbane to Nambour by car Participants accompanied by Ian Bally Accommodation: Red Bridge Motor Inn Nambour QLD four rooms booked http://www.redbridgemotorinn.com.au
4 Nov (Sun)	Rest /	

	Preparation	
5 -9 Nov (Mon-Fri)	First week in-house training with nursery businesses	4 citrus participants will work at Victorian Citrus Farms Pty Ltd 393 Woomera Ave Red Cliffs VIC, Ph 03 54281163 Transport – hire car; Tahir has booked a station wagon (3 Nov-15 Nov) \$682 includes 1200 Km
		4 mango participants will work at Birdwood nursery 71-83 Blackall Range Road, Nambour QLD, Ph 07 5442 1611
10-11 Nov (Sat-Sun)	Travel between training nurseries	Citrus participants travel Mildura to Brisbane by air QF2079 dep Mildura 10.05 arr Melbourne 11.10 (Tahir will bring them to Mildura airport) QF616 dep Melbourne 12.05 arr Brisbane 13.15 Brisbane to Nambour by Col's Shuttle Airport Shuttle, (07) 54505933 – leave airport every 45 min (cost \$50) door to door www.airshuttle.com.au
		Mango participants travel Nambour to Brisbane by Col's Shuttle Airport Shuttle, (07) 54505933 – leave airport every 45 min (cost \$50) door to door www.airshuttle.com.au Brisbane to Mildura by air JQ561 dep Brisbane 8.15 arr Melbourne 11.40 QF2082 dep Melbourne 13.50 arr Mildura 15.05 Participants met at Mildura airport by Tahir
12-14 Nov (Mon-Wed)	Second week in-house training with nursery businesses	4 citrus participants will work in Birdwood nursery, Nambour QLD 4 mango participants will work in Victorian Citrus Farms, Red Cliffs VIC
15 Nov (Thu)	Return to Sydney	Citrus participants travel Nambour to Brisbane by Col's Shuttle Airport Shuttle, (07) 54505933 – leave airport every 45 min (cost \$50) door to door www.airshuttle.com.au Brisbane to Sydney by air QF 521 dep Brisbane 10.25 arr Sydney 13.00
		Mango participants travel Mildura to Sydney by air QF2079 dep Mildura 10.05 arr Melbourne 11.10 (Steven will bring them to Mildura airport) QF430 dep Melbourne 12.00 arr Sydney 13.25
		Accommodation: Airport Sydney International Inn, \$150 / night (breakfast included). Shuttle bus from airport to hotel. www.airportinn.com.au
16 Nov (Fri)	Debrief seminar	Airport Sydney International Inn. Room hire \$200, catering \$50 / person = \$500.
17 Nov (Sat)	Participants depart for Pakistan	Shuttle bus from hotel to airport.

Visit 3: Itinerary for Trip to Spain 13-26 Nov 2012

Date	Location (Country/City)/Activity
11 Nov (Mon)	Mildura – Melbourne Melbourne - Bangkok (arrive 13/11/2012)
14 Nov (Wed)	Bangkok – Madrid Madrid - Valencia
15 Nov (Thu)	Visit Research centre and trial inspection (organised by Dr Maria Forner/staff) Visit commercial citrus orchards and packing sheds (Dr Maria Forner/staff)

16 Nov (Fri)	PowerPoint Presentation to staff and postgraduate student of research centre <ul style="list-style-type: none"> - Australian rootstock work and progress (Dr Tahir Khurshid) - Climatic effects on citrus phenological stages (Dr Tahir Khurshid) - Rootstock progress/new rootstocks (Dr Maria Forner) Discussions/Meetings – Import of Spanish rootstock for Australia
17 Nov (Sat)	TBA
18 Nov (Sun)	Start of 12 th citrus congress/registration/welcome reception
19 Nov (Mon)	Morning - Plenary sessions Evening – Workshops/posters
20 Nov (Tue)	Morning - Plenary sessions/posters Evening – Workshops/posters
21 Nov (Wed)	Mid Conference technical visit – Commercial orchard “Rincon de Gausa” 160 ha drip-irrigated grove in hill side
22 Nov (Thu)	Morning - Plenary sessions Evening – Workshops/posters/conference dinner
23 Nov (Fri)	Morning - Plenary sessions Evening – Workshops/posters/closing
24 Nov (Sat)	Valencia – Madrid Madrid – Bangkok (arrives 25/11/2012)
26 Nov (Mon)	Bangkok – Melbourne Melbourne - Mildura

Visit 4: Nursery training Thailand 22-28 Nov, 2014 Training coordinator: Dr Sakesan, Maejo University, Chiang Mai	
Date	Project activity/venue/city
21 Nov Friday	Tahir Khurshid will arrive to Chiang Mai in morning
22 Nov (Sat)	Pakistan group depart from Islamabad and Lahore; arrives Bangkok on Sunday morning
23 Nov (Sun)	The group arrive to Chiang Mai in morning Nursery pre-evaluation from Pakistan nurserymen/woman Stay: Suriwongse Hotel Chiang Mai
24 Nov (Mon)	Nursery training at Fang Travel to Fang in morning (2 vans are required to take trainees from Chiang Mai Fang/Chiang Mai – organised by Mr Kom) <ul style="list-style-type: none"> • Visit Citrus Nursery – Mr Bintoon/Kom • Reworking (we will need some trees to demonstrate reworking/ we will need a few bud sticks) – Kom/Jason Lunch <ul style="list-style-type: none"> • Orchard visit – Mr Kom • Packing house visit – Mr Kom Dinner at Restaurant at Fang hosted by Australian Team (Pakistan group/Thanathon staff) Stay: Hotel in Fang
25 Nov Tue	Nursery training at Fang/Chiang Mai <ul style="list-style-type: none"> • Cutting budwood demonstration in Fang – Jason & Kom (we will cut some budwood which will be used in Maejo University) • Depart for Chiang Mai – mid day (Check in to Hotel) • Nursery visits in Chiang Mai – Dr Sakesan/Dr Pathipan • Check training arrangements with - Dr Sakesan/Dr Pathipan (Dr Sakesan is arranging seed and rootstock seedlings for budding practice) Maejo will also arrange transport from 25 Nov to 27 Nov for visitors Stay: Suriwongse Hotel Chiang Mai
26 Nov Wed	Nursery training Maejo University <ul style="list-style-type: none"> • Introduction/opening (someone from Maejo university as per Dr Prawit suggestion)

	<ul style="list-style-type: none"> • Nurserymen (problems and issue) • Presentation by Dr Tahir Khurshid • Presentation by Dr Nerida Donovan <p>Lunch – arranged by Maejo University Practical session</p> <ul style="list-style-type: none"> • Chip budding techniques – Jason Bowes • Potting media – Mr Inam-ul-haq <p>Dinner for Dr Prawit, Dr Pathipan, Dr Sakesan and others staff from Maejo By Tahir (I can discuss this with Dr Sakesan) Stay: Suriwongse Hotel Chiang Mai</p>
27 Nov (Thu)	<p>Nursery training Maejo University</p> <ul style="list-style-type: none"> • Visit to plant market – Dr Sakesan • Nurserymen presentation/evaluation – what they learnt and their view • Certificate distribution • Closing <p>Stay: Suriwongse Hotel Chiang Mai</p>
28 Nov (Fri)	<p>Travel to Bangkok and onward travel to Australia Travel to Pakistan (Pakistani nurserymen)</p>

Visit 5: Itinerary for the Citrus group to Australia 9 Aug – 26 Aug, 2014	
Date	Project activity/venue/city
9 Aug (Sat)	Islamabad-Bangkok 23:20-6:25 TG 350 (arrive 11 Aug 6:25 am)
10 Aug (Sun)	<p>Bangkok-Melbourne 8:10-20:00 TG 461– overnight in Melbourne</p> <p>Stay: Atlantis Hotel, 300 Spencer street Melbourne (Phone: +61 3 96002900)</p>
11 Aug (Mon)	<p>Melbourne-Mildura</p> <ul style="list-style-type: none"> • 14:00 - Check-in for Mildura • 16:30 - Arrive in Mildura • 17:00 - Light shopping; Centro Mildura • 19:00 - Curry Tandoor, Indian Restaurant / Pakistan visitors <p>Stay: Aquarius Apartments, 836 A, 15th street Mildura (Phone: +61 3 50214822)</p>
12 Aug (Tue)	<p>Inspection of research trials at Dareton</p> <p>8:00 - Steven picks the group from hotel 9:00 - Trip briefing/induction (Tahir/Steven) 10:00 - Morning Tea Break 11:30 Dr Kazmi Presentation 12:00-13:00 – Lunch 13:00 Station trip Michael Treeby – Citrus Nutrition Graeme Sanderson – New varieties Tahir Khurshid – Rootstock work 15:00 Tea break 15:30 Depart for Mildura Breakfast & Dinner: Your own arrangements Stay: Aquarius Apartments, 836 A, 15th street Mildura (Phone: +61 3 50214822)</p>
13 Aug (Wed)	<p>Poster/Oral practice</p> <p>8:30 - Steven picks the group from hotel 9 am – IHC poster presentation practice with group (Tahir/Steven) 10:00 - Morning tea 10:30 - presentation practice continues 12:00 – Lunch 14:00 – MFC (Steven/Tahir/Mara Milner) 15:30 - Nursery Visit – (Steven/Tahir/Jason)</p>

	<p>Breakfast & Dinner: Your own arrangements Stay: Aquarius Apartments, 836 A, 15th street Mildura (Phone: +61 3 50214822)</p>
14 Aug (Thu)	<p>8:30 - Steven picks the group from hotel 9:00 - Irrigation design & installation (key points) - <i>Jeremy Giddings</i> (Core participants: Ayesha, Tauseef, Wajid, Ahmed Raza, Ghulam Nabi) 10 am – Morning tea 11:00 – Irrigation course continues... 12:00 Lunch 13:00 - Grower property visit 15:30 - Seven Fields 19:00 - Dinner cruise (Participants are informed) Stay: Aquarius Apartments, 836 A, 15th street Mildura (Phone: +61 3 50214822)</p>
15 Aug (Fri)	<p>8:30 - Steven picks the group from hotel 9:00 - Rootstock work and research collaboration – <i>Dr Maria Forner</i> 10:00 Morning tea 10:30 - Wentworth Lock and River Junction 12:00 – Lunch at Wentworth 14:30- Olam Orchards – Zubair Shahzad Breakfast & Dinner: Your own arrangements Stay: Aquarius Apartments, 836 A, 15th street Mildura (Phone: +61 3 50214822)</p>
16 Aug (Sat)	<p>8:30 - Steven and citrus group drives to airport picks the group from hotel Travel to Brisbane to attend conference Breakfast & Dinner: Your own arrangements Stay: Oak Charlotte Towers Hotel, 128 Charlotte street, Brisbane (Phone: +61 7 30278400)</p>
17 Aug (Sun)	<p>Attendance at conference Breakfast & Dinner: Your own arrangements Stay: Oak Charlotte Towers Hotel, 128 Charlotte street, Brisbane (Phone: +61 7 30278400)</p>
18 Aug (Mon)	<p>Attendance at conference and paper presentation / Report writing Breakfast & Dinner: Your own arrangements Stay: Oak Charlotte Towers Hotel, 128 Charlotte street, Brisbane (Phone: +61 7 30278400)</p>
19 Aug (Tue)	<p>Attendance in Symposium / Report Writing Breakfast & Dinner: Your own arrangements Stay: Oak Charlotte Towers Hotel, 128 Charlotte street, Brisbane (Phone: +61 7 30278400)</p>
20 Aug (Wed)	<p>Attendance at conference and paper presentation / Report writing Breakfast & Dinner: Your own arrangements Stay: Oak Charlotte Towers Hotel, 128 Charlotte street, Brisbane (Phone: +61 7 30278400)</p>
21 Aug (Thu)	<p>Attendance at conference and paper presentation / Report completed Breakfast & Dinner: Your own arrangements Stay: Oak Charlotte Towers Hotel, 128 Charlotte street, Brisbane (Phone: +61 7 30278400)</p>
22 Aug (Fri)	<p>Check-out from Hotel Brisbane-Sydney 14:00 - 20:20 TG 474 Breakfast & Dinner: Your own arrangements Stay: Aspire Hotel, 238 Bulwara Road, Ultimo, Sydney (Phone: +61 2)</p>
23 Aug (Sat)	<p>Rest day Breakfast, Lunch & Dinner: Your own arrangements Stay: Aspire Hotel, 238 Bulwara Road, Ultimo, Sydney (Phone: +61 2)</p>
24 Aug (Sun)	<p>Breakfast, Lunch & Dinner: Your own arrangements</p>
25 Aug (Mon)	<p>Sydney-Bangkok Bangkok-Islamabad</p>

Visit 6: Itinerary: ASLP Citrus industry exposure trip 17 Apr - 1 May, 2015 Hosted by Tahir Khurshid and Mr Steven Falivene	
Date	Project activity/venue/city
17 Apr (Fri)	Islamabad-Bangkok 23:25-6:25 TG 350 (arrives at 18 Apr)
18 Apr (Sat)	Bangkok-Melbourne – 8:10-20:00 TG 461 – overnight in Melbourne Stay: Cilom Airport Lodge, 398 Melrose Drive (Phone: +61 3 93352788)
19 Apr (Sun)	Melbourne – Mildura <ul style="list-style-type: none"> • 6 am – Depart hotel for airport 8:40-9:45 Melbourne-Mildura QF <ul style="list-style-type: none"> • Activities to be confirmed • 19:00 – Dinner at Restaurant in Mildura Stay: Hotel Commodore, Deakin Ave. Mildura (Phone: +61 3 50230241)
20 Apr (Mon)	Inspection of research trials at Dareton 8:00 - Driver picks the group from hotel <ul style="list-style-type: none"> • 9:00 -Trip briefing/induction (Tahir/Steven) • 10:00 - Morning Tea Break • 11:30 –12:00 Tahir Khurshid – Rootstock work/Arboretum • 12:00-13:00 – Lunch (TBA) • 13:00-14:00 Troy Witte – New varieties research • 14:00-16:00 Jeremy Giddings – irrigation management - Group 1 • 14:00-16:00 Steven Falivene – Pruning - Group 2 Dinner: Mildura Stay: Hotel Commodore, Deakin Ave. Mildura (Phone: +61 3 50230241)
21 Apr (Tue)	Packing shed and orchard <ul style="list-style-type: none"> • 9:00 – MFC (Tahir/Mara Milner) Ph: 50211644; • Lunch in Mildura • 13:00 -15:00 Seven fields, Citrus under netting (Steven) Dinner: Mildura Stay: Hotel Commodore, Deakin Ave. Mildura (Phone: +61 3 50230241)
22 Apr (Wed)	Nursery training/Growers visit <ul style="list-style-type: none"> • 9:00 - Trentham Farms – Chris George/Steven • Lunch • 13:00 - Sunmar Orchard Ellerslie Dinner: Mildura Stay: Hotel Commodore, Deakin Ave. Mildura (Phone: +61 3 50230241)
23 Apr (Thu)	Nursery training/Growers visit <ul style="list-style-type: none"> • 9:00 -Nursery visits and training (Sean/Tahir) Sean: 0419391558 • Lunch • 13:00 -Tarcoola and Hattah Farms (Steven/Tahir) Dinner: Mildura Stay: Hotel Commodore, Deakin Ave. Mildura (Phone: +61 3 50230241)
24 Apr (Fri)	OLAM Orchard Systems <ul style="list-style-type: none"> • Orchard visit – Adaptive management (Zubair Shahzad – Technical Services Specialist , Orchard Systems) • Lunch and Video (Mr Rob Wheatley- GM, Tim Vandenberg- Manager of Technical Services) • Processing Unit visit (Zubair Shahzad/Cameron Bell- Plant Manager) Zubair Phone: 0419730518

	Dinner: at Centro, Mildura Stay: Hotel Commodore, Deakin Ave. Mildura (Phone: +61 3 50230241)
25 Apr (Sat)	Travel to Sydney: Mild-Melb 10:05-11:00 QF2079 Melb-Syd 12:15-13:40 QF472 Dinner TBA Stay: Travel Lodge, Wynyard, 7-9 York Street, Sydney (Phone: +61 2 92741222)
26 Apr (Sun)	<ul style="list-style-type: none"> • Visit of Sydney Wharf Systems Dinner TBA Stay: Travel Lodge, Wynyard, 7-9 York Street, Sydney (Phone: +61 2 92741222)
27 Apr (Mon)	Travel to Brisbane/Bundaberg: Sydney-Brisbane:13:05-14:35 QF 328 Brisbane-Bundaberg 16:05-16:55 QF2324 Alexandra: 0741531037 (Bus) Stay at Kacey's Bagara Beach Motel, Bundaberg (Phone: 07 41301100)
28 Apr (Tue)	Travel to Gyandhah by Road (Bus has been arranged) <ul style="list-style-type: none"> • 11:00- Bevan Young (Ph: 0428616261; Home: 0741616261) • 13:00 - Visit GayPak (Ph: 0741612712; Verner Tonsing; 0407942516) • Lunch • 15:00 - Visit Ken Harris (Ph: 0427150523; 0741611294) • Dinner at Restaurant Stay: Billabong Motor Inn, 47 Strathdee Street Mundubbera (Phone: 07 41654533)
29 Apr (Wed)	Mundubbera <ul style="list-style-type: none"> • Ironbark Citrus; Allen & Susan Jenkins (0741654670) • Lunch • Dan Paptic; Bugs for Bug 13:00 • Dinner at Restaurant Stay: Billabong Motor Inn, 47 Strathdee Street Mundubbera (Phone: 07 41654533)
30 Apr (Thu)	Travel back to Bundaberg /Sydney: Bundaberg-Brisbane 12:10-13:00 QF2329 Brisbane-Sydney 14:25-17:00 QF537 Depart Mundubbera 8am Fly to Sydney – arrive 6pm Travel concludes Stay: Travel Lodge, Wynyard, 7-9 York Street, Sydney (Phone: +61 2 92741222)
1 May (Fri)	Sydney-Bangkok 10:00-16:20 TG 476 Bangkok-Islamabad 19:00-22:10 TG 349

11.3 Appendix 3: Conference Abstracts

The effect of furrow and flood irrigation system on water use efficiency and yield of sweet orange under ASLP citrus project with assistance from Australian aid program

Wajid, A¹, Khurshid, T², Naeem, N¹, Samad, A¹, Nabi, G³ and Giddings, J²

¹*Agriculture Research Institute Tarnab, Peshawar, Pakistan*

²*Dareton Primary Industries Institute, NSW DPI, Australia*

³*KP Agriculture University, Peshawar, Pakistan*

Flood irrigation is widely accepted practice in Pakistan for irrigating fruit crops. This method of irrigation is a standard practice in Khyber Pakhtunkhwa to irrigate citrus trees. The disadvantages of flood irrigation system are the water comes in contact with the tree trunk and it also causes root diseases and tree decline. This system also results in unnecessary water wastages. The objective of the trial was to enhance fruit yield and quality and also to save water using furrow irrigation system. Therefore, an under-tree twin furrow irrigation system was tested as an irrigation component of the Agriculture Sector Linkages Program (ASLP) citrus project funded by the Australian aid program. Furrow irrigation system was tested in a blood orange orchard at the Agriculture Research Institute, Tarnab Peshawar. Flume meter was used to monitor water use, while fruit yield was recorded at the commercial harvest. The results in May 2012 indicated that furrow irrigation used 140 L of water compared to 233 L in flood irrigation system. In 2012, the water used was 50 L in furrow irrigation system compared to 111 L in floor irrigation system. The yield data suggested an increased in yield using furrow irrigation system as compared to flood. Fruit yield were 121 kg/tree in furrow irrigation system as compared to 99 Kg/tree in flood irrigation system. The gross returns/ton was 7300 rupees to the growers. The benefits of furrow irrigation system and its mechanism are discussed in detail.

Hand thinning in 'Kinnow' mandarin to increase the size and quality of fruit under the ASLP citrus project in Pakistan with assistance from the Australian aid program

Tahir, T¹, Falivene, S. G², Khurshid, T²

¹University of Agriculture, Faisalabad, Pakistan, Australia

²Dareton Primary Industries Institute, NSW DP, Australia

Most of the citrus production in Pakistan (80%) is reliant on a mandarin type, cv. 'Kinnow', 95% of which is produced in the Punjab province. 'Kinnow' is grown in the Punjab districts of Sargodha, Toba Tek Singh, Lehea, Bhalwal, Khushab, Multan, Jhang, Mandi Bahauddin, and Mianwali. 'Kinnow' is a biennial bearing cultivar and crop load adjustment is needed to produce a regular crop of large sized fruit. Hand thinning is one of the crop management techniques to adjust crop load. However, fruit thinning was never practiced in Pakistan due to lack of knowledge among growers. Therefore, fruit thinning trials were initiated in 2012 at 5 different demonstration sites in citrus growing districts of Sargodha, Faisalabad and Toba Tek Singh. Crop load was adjusted to four different levels of fruit thinning and fruit were thinned to 11 fruits/frame 9 fruits/ frame, 7 fruits/ frame and non-thinned (>13 fruit/frame). During fruit thinning all diseased, blemished, deformed and undersized fruits were removed manually. One hundred fruits/tree was also tagged for fruit size estimation on fortnightly basis to develop a fruit size increment bar with reference to the fruit thinning. It was observed that the fruit thinning resulted in better fruit size and external fruit quality. The large sized fruit with good quality returned premium prices to the growers in the year of thinning compared to non-thinned fruit. Trees produced a balanced crop the year after thinning and alleviated biennial bearing. The data on fruit yield, size and external quality is discussed in more details.

The Comparison of Furrow and Flood Irrigation system in 'Kinnow' mandarin under an Australian aid program

Ahmad, R¹, Khurshid, T², Jaskani, J³, Naeem, N⁴, Nabi, G⁷, Hayat, A⁵, Tahir, T³, Ali, W⁴, Ur-Rahman, H⁶

¹*Pakistan Agriculture Research Council, Islamabad, Pakistan*

²*NSW DPI, Dareton, NSW, Australia*

³*University of Agriculture, Faisalabad, Pakistan*

⁴*Agriculture Research Institute, Tarnab, Pakistan*

⁵*Citrus Research Institute, Sargodha, Pakistan*

⁶*National Agriculture Research Centre, Islamabad, Pakistan*

⁷*KP Agriculture University, Peshawar, Pakistan*

Citrus is a major fruit crop in Pakistan, and “Kinnow” mandarin is the dominant cultivar. Currently 53% of citrus fruit produced in Pakistan is consumed domestically, and ca. 10% is exported. A small proportion is processed, and postharvest losses are high. Export of “Kinnow” mandarin from Pakistan is trending upwards, but the industry’s capacity to supply export markets is limited. A constraints analysis conducted under the auspices of the Agricultural Sector Linkages Program during 2006 suggested that the development of the Pakistan citrus industry was constrained by poor nursery practices, dependence on a limited range of varieties, poor irrigation and crop management practices. A project led by NSW DPI and collaborative organisations from Punjab and Khyber Pakhtunkhwa provinces in Pakistan has been funded by AusAid to increase citrus production in Pakistan through transfer of improved orchard management techniques. During the project 3 insect proof screen houses were built and modern nurseries have been established. Seven varieties of orange and mandarin were introduced and budwood has been provided to nurserymen to extend the harvest window in Pakistan. Furrow irrigation has been tested and now it has been adopted in KP province. The project has trained scientist and extension officers and upgraded their skills in crop management practices. Technology transfer is taking place *via* small to medium scale demonstration sites in citrus producing regions in Pakistan, and *via* more formal training of citrus research and extension personnel in Pakistan and Australia. This paper discusses in detail the outcomes of this project on nursery improvement, crop management, irrigation management and capacity building of extension officers and growers in Pakistan.

Evaluation of sweet orange (*Citrus sinensis*) scion varieties on Bigarade rootstock in Malakand district under the ASLP citrus project

Nisar, N¹, Nabi, G², Samad A¹, Khurshid, T³

¹*Agricultural Research Institute Tarnab, Peshawar, Pakistan*

²*The University of Agriculture Peshawar, AMK campus Mardan, Pakistan*

³*NSW Department of Primary Industries, Dareton, Australia*

An experiment on sweet orange (*Citrus Sinensis*) varieties budded on to Australian Bigarade rootstock was conducted at sub-tropical fruit Germplasm Unit Sherkhana Malakand, Khyber Pakhtunkhwa, during 2003-2012. The objective of the experiment was to evaluate 10 varieties (Sherkhana-1, Sanguinelli, Moro Blood, Hockney, Tarnab Malta, Marrs Early, Succari, Kozan, Blood Red and Musambi) were budded on to Australian Bigarade (*Citrus aurantium*) rootstock and to recommend the better performed variety for fruit yield and quality. The experiment was designed as a Randomized completely block with 3 two-tree replicates. Data on tree growth, fruit yield and quality was collected for 10 years from 2002 to 2012. The results indicated Sanguinelli, Hockney, Tarnab Malta had the maximum tree height. The tree volume was higher in Hockney and a higher tree trunk circumference was recorded in Tarnab Malta. Marrs Early had maximum fruit weight (175 g) followed by Tarnab Malta (169 g) and Moro Blood respectively. Hockney and Musambi had higher Total Sugar of 13% while Sherkhana-1, Moro Blood and Blood Red had higher juice acidity of 0.9%. Minimum sugar: acid ratio was found in Moro blood, while maximum in Hockney (24.6) and Musambi (23.2). Higher yield per tree was recorded in Sherkhana-1 (70.2 kg/tree), Tarnab Malta (70 kg/tree) and Musambi (65 kg/tree). It was concluded that Sherkhana-1 and Tarnab Malta produced higher yield and internal fruit quality on Australian Bigarade rootstock in climatic conditions of Malakand, Pakistan.

Effect of rootstock types on leaf mineral composition in three commercial citrus scion varieties of Pakistan

Muhammad Jafar Jaskani¹, Waqar Shafqat¹, Tauseef Tahir¹, Tahir Khurshid² and Hafeez-ur-Rahman³

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²Department of Primary Industries, Dareton 2717 NSW, Australia

³Horticultural Research Institute, National Agriculture Research Centre, Islamabad, Pakistan

Rootstocks play important role in solving problems in citrus orchards caused by soil, climate, insect pests and diseases. The major rootstocks used in Pakistan citrus industry are 'Rough Lemon' and sour orange. In this study leaf mineral composition of 'Kinnow', Feutrell's early and Mosambi grafted on eight rootstocks viz., Cox mandarin, Cleopatra mandarin, Fraser hybrid, sour orange, *Poncirus trifoliata*, Troyer citrange, Benton citrange, C-35 and Carrizo citrange was determined. Orchard soil and irrigation water was also analysed for canal and tube well (ground) water. Scion or rootstock significantly affected leaf nutrient composition in mandarin and orange plants. The results showed that rootstock types had significant influence on macro- and micronutrients especially the Na, Cl, N and B. The least influenced minerals in citrus leaf were Fe and Cu. The concentration of zinc and manganese were low in many of the scion and rootstock combinations. The scion cultivars also responded variably. The trees are yet unproductive but needs to explore their yield performance.

The extension activities of citrus project in Pakistan with assistance from the Australian aid program

Khan, M A¹, Khurshid, T², Shahbaz, M¹ and Ahmad, S¹

¹*Fruit and Vegetable Development Project, Lahore, Pakistan*

²*NSW DPI, Dareton, NSW, Australia*

The citrus project “the enhancement of value chain production in Pakistan and Australia through improved orchard management practices” activities in Pakistan were funded by the Australian Agency for International Development (AusAid) and implemented by the Australian Centre for International Agricultural Research (ACIAR). The project component for the Punjab province is a Joint collaboration of Agriculture Sector Linkages Program (ASLP) and Fruit and vegetable development project Punjab, which was initiated in 2011. The main objective of the project was to increase citrus production and improve fruit quality through improved orchard management practices. This objective was achieved through increasing the capacity building of citrus growers in crop management practices of marginalised and medium size growers. Therefore, FVDP established 4 farmer field schools (FFS) in 4 major citrus growing districts Sargodha, Mandi Bahauddin, Toba Tek Singh and Layyah. FVDP established 4 demonstrations sites for high Density Plantation (1 acre each), canopy Management (1 acre each) and good agriculture practices on citrus blocks (5 acre each) during the project life. The FFS program is the core activity of FVDP and it has trained 4450 grower in the last two years through FFS. The project was also able to send 42 SMS messages regarding crop management to 1150 growers. The project outcomes to improve the citrus production of the marginalised growers are presented.

Effect of Orchard Floor Management Practices on Soil Physical Properties, Growth and Yield of 'Kinnow' (*Citrus reticulata* Blanco)

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Improvement of soil physical properties through orchard floor management is a desired option because it results in improved yields due to better nutrients and water use efficiency. A study was carried out to determine the effect of weed management practices on growth, fruit production and changes in soil physico-chemical parameters in a citrus orchard. An orchard floor management studies were conducted using two treatments cultivation or mowing. In the cultivation (ploughing) treatment was applied using a tractor and weeds were controlled to minimal levels. In mowing treatment weeds were cut at ~ 5 cm height to keep their growth under control. The cut weeds were used as mulch and were thrown around the tree trunk. These treatments were applied every season in spring through summer and continued for 8 years. The data collected indicated that all the growth variables responded to management practices. Similarly soil physico-chemical parameters were also affected. Shoot growth, canopy diameter, Trunk Cross-sectional Area (TCSA) and fruit yield were increased. Soil bulk density was decreased and consequently soil porosity was increased. Mowing treatment promoted accumulation of soil organic matter and soil aggregation compared to cultivation (ploughing) treatment. The increased water retention in soil profile and enhanced saturated hydraulic conductivity were attributed to conditions conducive to organic matter accumulation in the soil profile. The results indicated superiority of mowing practice over conventional cultivation towards plant growth, yield and improvement in soil physical properties.

Enhancement of citrus industry through improved production practices in Pakistan under the AusAid Program

Ahmad, I¹, Khurshid, T², Jaskani, J³, Naeem, N⁴, Nabi, G⁷, Hayat, A⁵, Tahir, T³, Ali, W⁴, Ur-Rahman, H⁶

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Citrus is a major fruit crop in Pakistan, and “Kinnow” mandarin is the dominant cultivar. Currently 53% of citrus fruit produced in Pakistan is consumed domestically, and ca. 10% is exported. A small proportion is processed, and postharvest losses are high. Export of “Kinnow” mandarin from Pakistan is trending upwards, but the industry’s capacity to supply export markets is limited. A constraints analysis conducted under the auspices of the Agricultural Sector Linkages Program during 2006 suggested that the development of the Pakistan citrus industry was constrained by poor nursery practices, dependence on a limited range of varieties, poor irrigation and crop management practices. A project led by NSW DPI and collaborative organisations from Punjab and Khyber Pakhtunkhwa provinces in Pakistan has been funded by AusAid to increase citrus production in Pakistan through transfer of improved orchard management techniques. During the project 3 insect proof screen houses were built and modern nurseries have been established. Seven varieties of orange and mandarin were introduced and budwood has been provided to nurserymen to extend the harvest window in Pakistan. Furrow irrigation has been tested and now it has been adopted in KP province. The project has trained scientist and extension officers and upgraded their skills in crop management practices. Technology transfer is taking place *via* small to medium scale demonstration sites in citrus producing regions in Pakistan, and *via* more formal training of citrus research and extension personnel in Pakistan and Australia. This paper discusses in detail the outcomes of this project on nursery improvement, crop management, irrigation management and capacity building of extension officers and growers in Pakistan.

Improving citrus nursery production practices in Pakistan under the Australian aid program

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²*Elizabeth MacArthur Research Institute, NSW DPI, Menangle NSW, Australia*

²*Dareton Primary Industries Institute, NSW DPI, Australia*

The success of citrus industry depends on healthy trees which are produced in clean nurseries environment free from pest and diseases. Trees last longer in an orchard if it is raised as virus free tree and managed in orchard using appropriate water and nutrition program. However, in Pakistan there are no regulated nurseries with a proper infrastructure, or proper nutrition and irrigation programs. Trees produced in those nurseries are usually of poor health and inferior quality. Nurseries still heavily rely on the use of non-sterilised soil (dirt) and farm yard manure as a source of potting media. Soil media has often poor drainage, soil diseases and poor root growth. Therefore, the improvement of the nursery production practices was included into the citrus project funded by AusAid under the agriculture sector linkages program (ASLP) in Punjab and Khyber Pakhtunkhwa provinces. The aim was to provide clean infrastructure, deliver training in propagation techniques, development of clean potting media and provide nursery hygiene training. During the project three insect proof screen houses were built in citrus research institute, Sargodha; Agriculture research institute, Tarnab and national agriculture research centre, Islamabad. Virus free germplasm was imported from Australia and trees were propagated in clean screenhouses. Nurserymen were trained in propagation techniques and chip budding was adopted as a preferred propagation techniques over existing T-budding. Four commercial nurserymen were trained in Australia in nursery production practices and procedures. A range of workshops were held to demonstrate the preparation of potting media from locally available material. The outcome of the program and its benefits to the ordinary citrus nurserymen in Pakistan is discussed in this paper.

Effect of Rootstock Types on Leaf Mineral Composition in Three Commercial Citrus Scion Varieties of Pakistan under the ASLP Citrus Project

Jaskani, M J¹, Shafqat W¹, Tahir, T¹, Khurshid, T², Ur-Rahman H³

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²*Department of Primary Industries, Dareton 2717 NSW, Australia*

³*National Agriculture Research Centre, Islamabad, Pakistan*

More than 20 tree characteristics are influenced by rootstock. These include tree size, cropping efficiency and fruit quality attributes including fruit size. In Pakistan 'Rough Lemon' rootstock is used in Punjab and sour orange rootstock is used in Khyber Pakhtunkhwa. A study was designed to measure the leaf mineral content of scion varieties 'Kinnow', Feutrell's early and Mosambi grafted on to eight rootstocks Cox mandarin, Cleopatra mandarin, Fraser hybrid, sour orange, *Poncirus trifoliata*, Troyer citrange, Benton citrange, C-35 and Carrizo citrange. Soil analyses were carried out for nutrient content across different rootstock treatments. Irrigation water was analysed for canal and tube well (ground) water types. The results from this study indicated that scion or rootstock has significantly affected leaf nutrient content in mandarin and orange plants. The results showed that rootstock types had significant influence on macro- and micronutrients especially the Na, Cl, N and B. The least influenced minerals in citrus leaf were Fe and Cu. The concentration of zinc and manganese were low in many of the scion and rootstock combinations. The results are discussed in detail. The trees are yet unproductive but needs to explore their yield performance.

The Response of Phenological Stages to Climatic Extremes and its Effects on Citrus Production and Quality

Khurshid, T¹

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Phenology can be defined as the initiation or termination of programmed developmental stages responding to cues from day length, light and temperature. The length of phenological stages may vary from season to season because of season to season differences in weather conditions, particularly temperature. The impact of temperature is encapsulated in the heat unit concept. Most variability in phenology is accounted for by variability in the time taken to accumulate a certain number of heat units using upper and lower temperate thresholds. Therefore, different phenological stages during the growth cycle of citrus tree is affected by the extreme temperatures if the range is out of the optimum limits. In the last few years certain phenological stages such as flowering, fruit colour, fruit sunburn and fruit maturity has been affected due the unexpected rise in temperatures. The data on the effect of climatic conditions on different phenological stages is presented with special reference to climatic extremes in recent years. All these changes can ultimately affect the values chains.

Introduction of a more effective 'Kinnow' mandarin fruit payment system in Pakistan under Australian Aid project

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⁴*National Agriculture Research Council, Islamabad, Pakistan*

Most of the 'Kinnow' mandarin fruit in Pakistan is sold by growers 'on-tree' (to contractors) in the early to mid-stages of fruit development. Fruit are assessed on-tree for yield and potential quality and a price is negotiated. There is no incentive for growers to implement improved practices because they will not receive any more money at harvest. This limits the success of extension programs that promote quality fruit growing practices. Most 'Kinnow' orchards in Pakistan produce significantly less high quality export grade fruit as compared to other quality payment based production countries. A desktop study identified that if a quality based payment system that reflects market prices is adopted in Pakistan, growers can potentially double their returns. The increase in returns is based on an increase in prices due to the increased production of higher quality fruit. If the whole of industry can grow higher quality fruit, this will raise the profile of Pakistan 'Kinnow' fruit at export markets further increasing demand and returns. The AusAid citrus project has initiated two quality payment orchard demonstration sites in Pakistan. These sites are being managed to grow quality fruit and to sell the fruit at market prices. The results and outcomes of the quality payment demonstration exercise are presented in detail.

The Effect of Chinese Rootstocks on Tree Growth, Fruit Yield and Quality of Citrus under Sunraysia Conditions in Australia

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The national citrus rootstock improvement program of Australia is a multi-stage process involving glasshouse screening for seed characteristics, Chinese and Vietnamese rootstocks were imported to Australia in 1993/1994 and rootstocks were screened for the seedling uniformity, graft compatibility, disease resistance and salt tolerance followed by an orchard evaluation with a range of scion varieties. The objective of the trials was to select Chinese rootstocks which outperform the standard Australian rootstocks for fruit yield, fruit quality and small tree size. Thirteen experimental trials for Chinese and Vietnamese rootstocks were conducted at different stages at Dareton research station. Mixed rootstock types were planted in 1999 and trifoliata type rootstocks were planted in 2001. Vietnamese rootstocks mainly mandarin type was planted in 2005. Rootstocks in each planting were grafted on to Navelina, Lane Late navel, Eureka Lemon and Imperial mandarin. Data for yield, fruit quality, fruit size distribution and tree growth was collected for 10 years for each stage of planting. The recommended rootstocks Donghai, Tange, Zao yang, Ghana, Cao xi, Anjiang hongju from the first phase of research evaluation and now are being tested in semi-commercial orchards in Riverina; while the salt tolerant rootstocks identified in this program are being tested in Bindoon, Western Australia. The Australian rootstock program has now established strong links with the Spanish breeding and rootstock evaluation program to test the recommended Chinese material in Spain; while promising Spanish rootstocks will be under Australian conditions. The entire program is discussed in detail and data is presented on yield and quality.

Enhancement of citrus value chain production in Pakistan and Australia under the AusAid Program

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⁷*Pakistan Agriculture Research Council, Islamabad, Pakistan*

Citrus is a major fruit crop in Pakistan, and “Kinnow” mandarin is the dominant cultivar. Currently 53% of citrus fruit produced in Pakistan is consumed domestically, and ca. 10% is exported. A small proportion is processed, and postharvest losses are high. Export of “Kinnow” mandarin from Pakistan is trending upwards, but the industry’s capacity to supply export markets is limited. A constraints analysis conducted under the auspices of the Agricultural Sector Linkages Program during 2006 suggested that the development of the Pakistan citrus industry was constrained by poor nursery practices, dependence on a limited range of varieties, poor irrigation and crop management practices. A project led by NSW DPI and collaborative organisations in Pakistan including, the Pakistan Agriculture Research Council, Islamabad, the Citrus Research Institute, Sargodha, the University of Agriculture, Faisalabad, the Agriculture Research Institute, Tarnab Peshawar and Fruit and Vegetable Development Project, Lahore has been funded by AusAid to increase citrus production in Pakistan through transfer of improved orchard management techniques. The overall aim of this project is to improve mandarin and orange productivity in Pakistan through germplasm transfer and to extend the growing season, to test a range of varieties in the hotter climate of Pakistan, provide training in the areas of nursery production, irrigation and orchard management. Technology transfer is taking place *via* small to medium scale demonstration sites in citrus producing regions in Pakistan, and *via* more formal training of citrus research and extension personnel in Pakistan and Australia.

The evaluation of Chinese rootstock for tree growth, yield and quality of Lane Late oranges grown in Australia

***Tahir Khurshid*¹, *Graeme Sanderson*¹ and *Nerida Donovan*²**

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²*NSW DPI, Elizabeth MacArthur Research Institute, Menangle NSW, Australia*

This paper reports on the short term performance of a range of new rootstocks imported from China. The experimental program was conducted at the Dareton Primary Industries Institute, New South Wales Department of Primary Industries beginning in 1997. A detailed data is presented from a Lane Late trial which was propagated on to a range of rootstock treatments including *Citrus reticulata*, *Poncirus trifoliata*, *P. trifoliata* hybrid, *C. junos*, *C. erythrosa*, *C. aurantium* hybrid, *P. trifoliata* (Tri22 Australian strain), *C. sinensis* and (*C. sinensis* x *P. trifoliata*). The Australian standard Tri22 was used for comparison purposes. This trial was established in October 1999 to evaluate the horticultural performance of new rootstocks established from single-node cuttings with a Lane Late scion. Six years of data (2002-2007) were collected on tree growth, fruit yield and quality to identify superior rootstocks for the next phase of semi commercial plantings. Chinese *Poncirus trifoliata* type, Houpi and Zao Yang resulted in higher cumulative yields of 127 kg/tree and 115 kg/tree, respectively compared to 81 kg/tree for the control (Tri22), and yield efficiencies of 2.4 and 3.2 kg/cm², respectively compared to 2.5 kg/cm² were produced. Houpi had a large trunk circumference of 26 cm compared to Tri22 while Zao Yang had a similar trunk circumference of 20 cm compared to Tri22. Data on tree growth, fruit quality and fruit size distribution are presented for all other rootstocks.

11.4 Appendix 4: List of Postgraduate Students

Postgraduate students at the University of Agriculture, Faisalabad

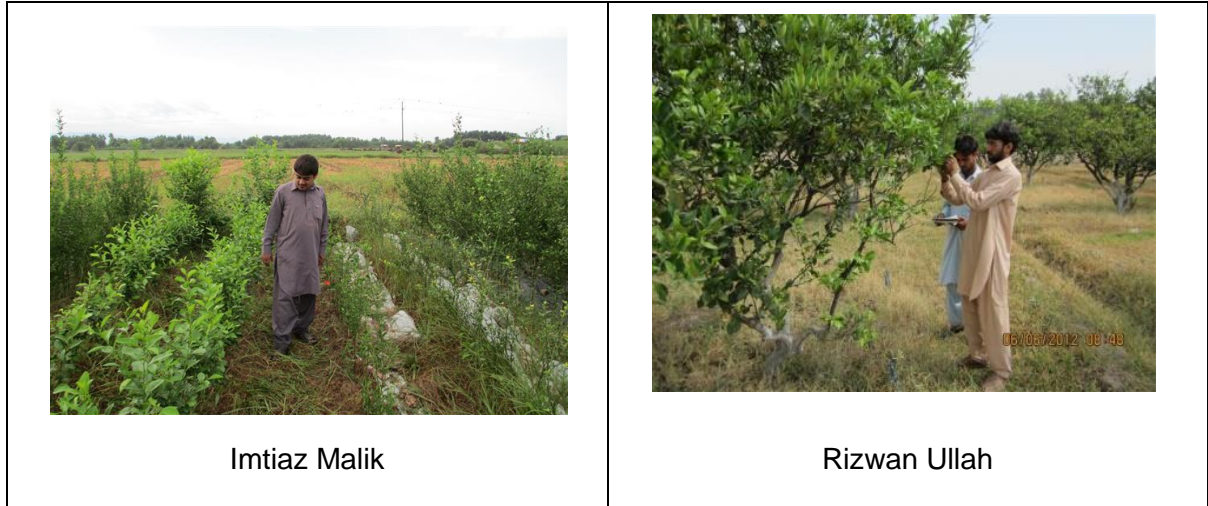
	Name	Research Title	Status (Year)
1	Ms Sadia Afzal	Response of 'Rough Lemon' (<i>Citrus jambhiri</i> L) seedling against different potting media	MSc (Hos.) 2013 - completed
2	Mr Waqar Shafqat	Effect of Rootstock types on leaf nutrient composition of three Citrus Scion varieties	MSc (Hos.) 2014 - completed
3	Ms Fareeha Shireen	Effect of chemical thinning on growth and fruit quality of 'Kinnow' mandarin (<i>Citrus reticulata</i> Blanco)	MSc (Hos.) 2015 - (near completion)
4	Ms Nergis Fatima	Effect of fruit thinning on quality and profitability of 'Kinnow' mandarin (<i>Citrus reticulata</i> Blanco)	PhD 2015 - underway

Postgraduate students at the University of Agriculture, Peshawar

	Name	Research Title	Status (Year)
5	Mr Muhammad Naeem	Response of Lemon cultivars to Cox Orange mandarin rootstock	BSc (Hos.) 2014 (completed)
6	Mr Muneer Rehman	Performance of citrus rootstocks in different potting media under the screenhouse conditions	MSc (Hos.) 2012 (completed)
7	Mr Imtiaz Malik	Response of sweet orange cultivars budded on citrus rootstocks under the climatic conditions of Peshawar.	MSc (Hos.) 2013 (completed)
8	Mr Zia Ur Rahman	Growth responses of the Australian sweet orange varieties on different rootstocks in the climatic conditions of Peshawar.	MSc (Hos.) 2014 (completed)
9	Mr Rizwal Ullah	Influence of Gibberellic acid on fruit set and growth of sweet orange.	MSc (Hos.) 2012 (completed)

Postgraduate students





11.4.1 Postgraduate JAF Scholar

Mr Muneer Rehman was able to get a JAF scholarship and he is pursuing a PhD in postharvest physiology at the Curtin University, Perth Australia under the supervision of Dr Zora Singh and Dr Tahir Khurshid.

The main objectives of his research will be:

1. Pre-harvest regulation of levels of carotenoids (β -carotene, β - cryptoxanthin, lutein, violaxanthin, 9-*cis* violaxanthin) and chlorophyll in the rind and fruit colour development and quality of early maturing M7 sweet orange.
2. Determination of role of harvest maturity and storage temperatures in extending storage life and maintain fruit quality in late maturing cultivar Midnight Valencia sweet orange
3. Investigation of the role of postharvest application of plant growth regulators and storage temperature in extending storage life and maintain fruit quality in late maturing cultivar Midnight Valencia sweet orange.

Mr Muneer Rehman (Right) successful JAF Scholar at Curtin University with his supervisor Dr Zora Singh (Left)



11.5 Appendix 5: Training activities (Mar 2011- Sep 2015)

The project officially started on 30 April 2011; however, the activities shown below are from 8 March 2011 – 30 Sep 2015.

- **8 March 11** – Reworking training was provided to growers at ARI (35).
- **22 Oct 11** - Dr Tahir Khurshid trained the project officers and collaborative staff in recording the Flume data from furrow and flood irrigation trials (10).
- **24 Oct 11** - Training at FFS at Mr M Ilyas Warriach orchards, Sargodha. Tahir Khurshid and Mary Cannard interacted with growers and made presentations (50).
26 Oct 11 – Dr Tahir Khurshid made “Fruit thinning of ‘Kinnow’ presentation and trained ATI extension district officers (25).
- **5 Dec 11** - Training in crop estimation by Dr Ghulam Nabi at ARI (40).
- **16 Jan 12** – Dr Hafeez-ur-Rahman delivered lectures titled **1.** “Cost-effective & environment friendly orchard floor management” **2.** “Nutritional requirement of Citrus orchard” **3.** “Citrus pruning” to the in-service trainee’s agriculture officers (AO extension) at In-service Agriculture Training Institute (ATI), Sargodha (13).
- **24 Jan 12** – a Farmer field day was held at Toba Tek Singh, citrus region (200 growers).
- **4 Feb 12** - Citrus Nursery Management Training was organized at UAF. It was participated by Nurserymen from District Jhang, Layyah & Bhakar (participants: 45)
- **25 Feb 12** - Workshop on pruning of Citrus was organized by ARI, Tarnab Peshawar; under ASLP Citrus Project at Palai Sher Khana, Malakand Agency. Citrus growers were trained during the workshop. Dr. Ghulam Nabi elaborated on the benefits of pruning and demonstrated to the pruning methodology to the KP growers (30).
- **12 Mar 12** - Re-Working Training at PARS UAF (2012). Attended by Graduate & Postgraduate Students (Participants: 24)
- **14 Apr 12** – Reworking workshop at ARI, Tarnab (35 participants)
- **14 Apr 12** – Reworking workshop at CRI, Sargodha (45 participants)
- **19-23 Apr 12** - Dr Abdul Samad and Asif Khan obtained training in crop management and nursery management.
- **24 Apr 12** – Training in nursery management and a visit to the grower’s property.
- **7 May 12** – Soil solution training for extension officers and project collaborators at CRI (15)
- **9 May 12** - Citrus growers conference Day 1 (200 participants)
- **10 May 12** – Citrus growers conference Day 2 (150 participants)
- **11 May 12** – Soil solution and fruit thinning training by Steven Falivene to student of UAF at the PARS orchard (60 students)
- **12 May 2** – Mega field day on citrus nutrition and fruit thinning by Steven Falivene and Dr Tahir Khurshid (500 growers)

- **13 May 12** – Audio-visual training to project officers and collaborators at UAF (5)
- **7 Jun 12** - Nutrition training workshop by ARI to growers (45 participants)
- **20 Aug-2 Sep 12** – Two project officers (Tauseef Tahir and Wajid Ali) from Pakistan visited NSW DPI for crop management trainings and exposure to citrus industry.
- **10 Sep 12** – Dr Tahir Khurshid and Mr Jeremy Giddings (irrigation officer) visited CRI, Sargodha and inspected the drip and sprinkler irrigation system. Jeremy Giddings suggested planting the young trees in 2 rows where there was space available at the end of the row. The purpose of the exercise was to test the response of younger trees to the current irrigation system. Jeremy demonstrated the system cleaning and pressure calibration to the CRI scientist and 2 project officers (15).
- **4 Oct 13** – Nursery training at NARC Islamabad was carried out for nurserymen from KP, Islamabad, Rawalpindi and Haripur area. Dr Tahir Khurshid presented a PowerPoint related to nursery production and operation in Australia. Dr Nerida Donovan presented detailed PowerPoints on quarantine related issues and nursery hygiene. Mr Jason Bowes, a commercial nurseryman from Australia, conducted a hands-on session on chip budding at NARC nursery. Mr Inam-ur-Haq demonstrated practical procedure of potting media preparation. There were 7 female nursery women who participated in the nursery workshop. Steven Falivene and Tauseef Tahir filmed videos during the training on chip budding and potting media preparation. Certificates were distributed among the training participants who completed the training course.
- **5 Oct 13** - Nursery training at Agriculture Training Institute (ATI) Sargodha was carried out for nurserymen from Sargodha and Mandi Bhaudin citrus regions. Field officers and extension officers also participated in the nursery training. Dr Tahir Khurshid presented a PowerPoint related to nursery production and operation in Australia. Dr Nerida Donovan presented detailed PowerPoints on quarantine related issues and nursery hygiene. Mr Jason Bowes, a commercial nurseryman from Australia conducted a hands-on session on chip budding at NARC nursery. Mr Inam-ur-Haq conducted a practical demonstration on potting media preparation. Certificates were provided to all training participants who completed the training course.

The project team also visited Mr Ilyas's irrigation trial site. Irrigation system has recently installed on this property.

- **7 Oct 13** – Nursery training for commercial nurserymen occurred at UAF Faisalabad. Participants include nurserymen from Faisalabad, Toba Tek Singh and Okara citrus regions. Toba Tek Singh is the second major region of citrus after Sargodha in Punjab province. We also included postgraduate students and 5 faculty member from the university. Ten female postgraduate students also participated in the training. The workshop included a forum where participants were asked about nursery industry issues and feedback was provided by the project team. Dr Tahir Khurshid presented a PowerPoint related to nursery production and operation in Australia. Dr Nerida Donovan presented detailed PowerPoints on quarantine related issues and nursery hygiene. Mr Jason Bowes, a commercial nurseryman from Australia

conducted a hand-on session on chip budding at UAF nursery. Mr Inam-ur-Haq demonstrated practical procedure of potting media preparation. There were 7 female nursery women who participated in the nursery workshop. Tauseef Tahir prepared videos on chip budding and potting media. Certificates were distributed among the training participants who completed the training course.

- **22 Oct 12** – CRI and ARI staffs were trained at CRI in data collection and fruit growth measurements (10).
- **Nov 12** – 4 nurserymen trained at Victorian Farm Nurseries, Mildura, Australia.
- **7 Dec 12** - Training workshop on “nursery raising and citrus orchard management” was held at ARI, Tarnab, Peshawar (30 participants)
- **22Jan 13** - Pruning training for growers at CRI, Punjab (75 participants)
- **23 Jan 13** - Training on soil solution and the use of Full stop (monitoring equipment) at CRI Sargodha by Tauseef Tahir (Participants: 16)
- **9 Feb 13** - Pruning training at ARI, Tarnab (80 participants)
- **11 Feb 13** - Citrus Nursery Raising & Management training at village 309 GB Toba Tek Singh by Dr. Jaskani & Tauseef (Participants: 24)
- **11 Feb 13** -Training workshop on “Pruning in Citrus Orchards” at ARI Tarnab, Peshawar. (Participants: 30)
- **13 Feb 13** - Citrus Nursery Raising & Management training at Al-Imran Nursery Pattoki by Dr. Jaskani & Tauseef (Participants: 19)
- **18 Feb 13** - Training workshop on “Citrus Fruit Harvesting” by Mr. Steven Falivene at CRI, Sargodha (Participants: 30)
- **19 Feb 13** – Nursery day on “Nursery management practices” at CRI Sargodha (Participants: 37). Nurserymen from KP travelled to Sargodha to participate in the workshop, while a vast majority of local nurserymen from Punjab also participated along with scientist from CRI and a few extension workers. Dr Daud Rehman has recently obtained training in Australia under the Ag capability program delivered a lecture on the Australian nursery system. He also shared his experiences with the local nurserymen. A second session was conducted by Mr Inam-ul-Haq from Mango team. Mr Inam brought different ingredients of his potting media and demonstrated the preparation of potting media. Mr Steven Falivene demonstrated the testing of the potting media. In afternoon session, Dr Daud-ur-Rehman did a practical demonstration of chip budding to the local nurserymen. He also provided the information of the benefits of chip budding.
- **22 Feb 13** - Citrus Pruning & Reworking training at UAF by Mr. Steven Falivene (Participants: 55)
- **23 Feb 13** – Dr Tahir Khurshid conducted a workshop on the phenological stages of citrus to the growers of Sargodha and Toba Tek Singh citrus growing regions. A distribution of phenology calendar among growers was followed by the workshop. Mr Steven Falivene conducted a grower’s forum on the quality payment system to the growers. At the end of the forum 2 volunteer growers were selected to participate in the quality payment system.
- **16 Mar 13** – Reworking workshop at NARC, Islamabad (Participants: 60)
- **18 Mar 13** – Nursery management on local TV Channel, Islamabad.

- **28 Mar 13** – Training workshop “Potting media preparation and quality determination techniques” ARI, Tarnab (Participants: 42)
- **6 Apr 13** - Training workshop on “Fruits Orchards management techniques” in collaboration with provincial government funded project “Rehabilitation of flood affected land through plantation of new orchards” at Harichand, Charsadda (Participants: 300)
- **9 Apr 13** – Nursery management on local TV Channel, Islamabad.
- **10 Apr 13** – Nursery management training to student of Bahudin Zikriya University
- **10 Apr 13** - Training workshop on “Reworking Technique in Citrus” by Akbar Hayat at Hamid Saleem Orchard, Sargodha (Participants: 35)
- **11 Apr 13** - Training workshop on “Reworking in Citrus Trees” ARI Tarnab, Peshawar (Participants: 33)
- **27 Apr 13** - Training workshop on “Reworking in Citrus” by Akbar Hayat at CRI, Sargodha (Participants: 40)
- **6 May 13** - Training to PhD Students regarding Fruit Thinning and fruit Size estimation in citrus and reduction of blemishes and Thrips attack to improve the citrus fruit quality.
- **23 May 13** - Training workshop on Citrus orchard management techniques of citrus orchards” in collaboration with provincial government funded project “Rehabilitation of flood affected land through plantation of new orchards” at Kaka Sahib, Nowshera. (Participants: 264)
- **28 May 13** - Training workshop on “orchard management techniques” in collaboration with provincial government funded project “Rehabilitation of flood affected land through plantation of new orchards” on 28/5/2013 at Umar Miana, Peshawar. (Participants: 300)
- **18 Jul 13** - Soil & water testing, training at Village 330GB, Toba Tek Singh by Tauseef Tahir (Participants: 36)
- **18 Jul 13** - Fruit thinning training at Village 332GB, Toba Tek Singh by Tauseef Tahir (Participants: 22)
- **19 Sep 13** - Briefing on nursery work was given to farmers from the Mohmand agency on “Citrus nursery production under screen house conditions” (Participants: 75)
- **4 Oct 13** - Training workshop on “Nursery Management” at NARC, Islamabad (Participants: 50)
- **5 Oct 13** - Training workshop on “Chip Budding and Media Preparation” by Dr Tahir Khurshid, Dr Nerida Donovan and Mr Jason Bowes at CRI Sargodha (Participants: 67)
- **7 Oct 13** - Training on Citrus Nursery Management, budding and potting media at UAF. Training was provided by Dr. Nerida, Mr. Jason Bowes & Mr. Faisal Inam organized by Dr Jaskani & Tauseef Tahir (Participants: 77)
- **8 Oct 13** - Training on Citrus Reworking at UAF Faisalabad by Mr. Jason Bowes organized by Dr Jaskani & Tauseef (Participants: 19)
- **2 Nov 13** - Training workshop on “Improved citrus Orchard Management Practices” at quality payment system site Akorra Khattak by Dr Tahir Khurshid (Participants: 25)
- **22-28 Nov 14** – Thirteen nursery men, nurserywomen, researchers and 2 PhD Student visited Mae Jo University Thailand for training on “Nursery

- Raising & Its management”. The group was headed by Dr Tahir Khurshid and Dr Nerida Donovan along with a Jason Bowes (a private nurseryman from Australia)
- **18 Dec 13** - Training workshop on “Improved Citrus Orchard Management Practices” at quality payment system site Mardan (Participants: 34)
 - **22 Jan 14** - Workshop on pruning of citrus was conducted at Chak No. 83 SB, Sargodha by CRI staff (Participants: 24)
 - **28 Feb 14** - Citrus seminar on citrus production technology organized by CRI and FFS (participants: 65)
 - **11 & 12 Mar 14** - Pruning workshop was conducted fir citrus growers by the FVDP held in 91 SB & 47 SB, Sargodha on 11th & 12th March, 2014. Wajid Ali demonstrated the pruning techniques in Punjab (Participants:105)
 - **12 Mar 14** - Lecture on “Tropical Horticulture and Cluster Formation Strategies of Philippines” at UAF by Mr. John Oakeshott, Horticultural Manager of ACIAR at Philippines to the Faculty staff, Researchers and Students. (Participants: 250)
 - **22 Mar 14** - One day training workshop was organised for the students of University of Sargodha at CRI (Participants: 16)
 - **25 Mar 14** - Training workshop was organized by ARI on “Citrus Best Orchard Management Practices” in Huwaii, Kaka Sahib, Nowshera. (Participants: 48)
 - **25 Mar 14** - Citrus seminar on citrus production technology organized with collaboration of Fauji Fertilizer Company at Bhalwal, Sargodha (Participants: 200)
 - **25 Mar 14** - Training workshop on “Citrus Best Orchard Management Practices” in Hawaii, Kaka Sahib, Nowshera.(Participants: 48)
 - **7 Apr 14** - Two irrigation management training workshops was held at the University of Faisalabad for extension officers and citrus growers of Sargodha region. Training was delivered by Jeremy Giddings with assistance from Dr Tahir Khurshid and Ms Ayesha Arif (Participants: 70)
 - **9 Apr 14** - Two irrigation management training workshops was held at the Bahau-din-Zakariya University Multan. Extension officers and citrus/mango/cotton growers of Multan participated in irrigation management training. Training was delivered by Jeremy Giddings with assistance from Dr Tahir Khurshid and Ms Ayesha Arif (Participants: 70)
 - **10 Apr 14** - Irrigation management training workshops was held for mango growers at Asim Farms Limited, Jamshoro, Sindh. Training was delivered by Jeremy Giddings (Participants: 8)
 - **10 Apr 14** - Seminar/ Training on “High Health Citrus and Mango Nursery Promotion through Modern Techniques in Pakistan” at College of Agriculture Layyah, Sub Campus of BZU Multan. (Participants: 250)
 - **11 Apr 14** – Two irrigation management training workshops was held at the Sindh University, Jamshoro. Extension officers and mango/vegetable growers of Jamshoro region participated in the training. Training was delivered by Jeremy Giddings with assistance from Dr Tahir Khurshid and Mr Munawar Kazmi (Participants:75)

- **7 May 14** – Workshop on “Best orchard management practices in citrus and quality payment system” was conducted by Mr Nisar Naeem and Wajid Ali, at Mian Amir Gul Kaka Khel property in Abazai Tangi Charsada (Participants: 50)
- **5 Jun 14** - Training workshop on “Importance of Furrow Irrigation System in Fruit Orchards” at Hujra of Razim Khan, Urmar Miana, and Peshawar with the collaboration of ADP Project “Rehabilitation of flood affected lands through plantation of new orchards’ (Participants: 165)
- **17 Sep 14** - Training on “Furrow Irrigation System in Fruit Orchards” In collaboration with ADP Project “Rehabilitation of flood affected lands through plantation of new orchards” At Budhni, Peshawar. (Participants: 191)
- **5 Dec 14** - Delivered lecture on “Citrus Orchard Management Practices during the Dormant Season” during a training arranged by the ASLP Social team in collaboration with ASLP Citrus Project Phase-II in Tangi Khattak, Nowshera on (Participants: 28)
- **24 Dec 14** - Training on “Orchard Management in Dormant Season” in Urmar Payan, Peshawar under the ADP (Annual Development Plan) Project “Rehabilitation of flood affected lands through plantation of new orchards” with the collaboration of ASLP Citrus Project P-II (Participants: 250)
- **20 Jan 15** - Farmer Field Day at QPS sites Conducted by Tauseef Tahir to aware the growers about QPS, Practices and its outcome Village # 91 SB Sargodha (Mr. Zubair: QPS Grower) (Participants: 48)
- **24 Jan 15** - Farmer Field Day at QPS sites by Tauseef Tahir to aware the growers about QPS, Practices and its outcome Village # 83 SB Sargodha (Mr. Illyas Warriach: QPS Grower) (Participants: 32)
- **26 Jan 15** - Farmer Field Day at QPS sites to aware the growers about QPS, Practices and its outcome Village 4 SB Bhalwal-Sargodha (Mr. Hamad Tarar: QPS Grower) (Participants: 40)
- **29 Jan 15** -Training workshop on “Best Orchard Management Practices” in Quality Payment system site in Ghaladher, Mardan. (Participants: 45)
- **8 Feb 15** - Farmer Field Day on Pruning “Practical demonstration of Pruning Practice in Citrus” Village 332 GB, Toba Tek Singh (Grower: Mr. Abdul Aziz Tariq) (participants: 54)
- **10 -12 Feb 15** -Three days training workshop on “Citrus Nursery Raising Techniques” at ARI Tarnab, Peshawar under ASLP Citrus Project Phase-II. (Participants: 30)
- **16 Mar 15** - Practical Demonstration Trainings on Top Working Technique at Toba Tek Singh (16 participants)
- **3 Apr 15** - Training workshop arranged for Agriculture Extension Officer at Agricultural Research Institute Tarnab, Peshawar. (Participants: 11)

Communication

The project officially started on 30 April 2011; however, the activities shown below are from 5 Jan 2011–30 Sep 2015.

- **5 Jan 11** - A visit was made to the commercial citrus company “Thanathon Orchards” Fang, Chiang Mai in Thailand. Dr Khurshid conducted a packing shed audit at the packing shed.

- **6 Jan 11** - Lecture on the Australian Citrus Industry delivered by Dr Tahir Khurshid to staff and postgraduate students at the Maejo University, Chiang Mai (70).
- **9 Jan 11** - Project meeting with Dr Hafeez and Dr Kazmi and Mr Jawad Qadir, (Irrigation provider from 4B) at Awari Hotel, Lahore.
- **10 Jan 11** - Meeting with Mr Asif Khan (Director, FVDP), Mr Khalid Mahmood (Provincial Focal person), Tahir Jameel (Deputy Director, FVDP), Sajid Ahmad, Shabaz Khaloon, Dr Munawar Kazmi and Dr Hafeez-ur-Rahman.
- **11 Jan 11** - Meeting and PowerPoint presentation about the project progress to the secretary Agriculture Mr Farhan Aziz Khawaja (Special Secretary Agriculture Marketing) Punjab and other Directors. The Secretary was interested in the expansion of citrus production to other areas of Pakistan. The Secretary was emphasised on the continuation of the training activities after the completion of ASLP citrus project.
- **11 Jan 11** - A project planning meeting was held with Dr Mohammad Jaskani and Dr Mazhar at UAF. Dr Jaskani presented the project progress report on a PowerPoint which was followed by a group discussion.
- **12 Jan 11** – Field session and trial sites visits were conducted at UAF. Collaborators from, ARI, FVDP and UAF presented the project progress.
- **12 Jan 11** - A meeting was held with Rana Javaid Iqbal Anjum (Director – ATI). The institute offers in-service training and 3 year diplomas. The involvement of students in various crop management activities of the CRI and ASLP project for the future collaboration was discussed.
- **12 Jan 11** - A visit was made to the commercial citrus packer Mr Qasim Ijaz from Roshan enterprises. Dr Khurshid conducted a packing shed audit at the Roshan Enterprises.
- **13 Jan 11** - A meeting was held with the VC to discuss the new project and UAF's involvement in the nursery component. The meeting went well and Dr Iqrar Khan was happy to provide his full support. Dr Iqrar Khan was interested in the issue of standardising potting media. Currently, the potting media being used in Pakistani citrus nurseries is not appropriate as it contains silt or dirt along with sand. Dr Iqrar Khan wants something done about it fairly quickly. We discussed possible alternative potting media. Since then, I have discussed this issue with Chinese collaborators at CRI, Beibei in Nov 2011 and May 2012. A nurseryman in Melbourne has already been consulted about training the project staff in potting media preparation.
- **13 Jan 11** - A full day project planning meeting was held at the UAF for the project collaborators. The project collaborators Dr Ghulam Nabi (ARI), Mr Altaf-ur-Rahman (CRI) and Dr Jaffar Jaskani (UAF) presented project progress via PowerPoint presentations. After the presentations there was a combined discussion session. The discussion session was followed by development and discussion of the plan for the ASLP Phase 2 project.
- **14 Jan 11** - I visited the Chairman of PARC and exchanged views about the new project. I also made a PowerPoint presentation about progress of the previous project and outlined the objectives for the new project. Dr Afzal appreciated the project progress and further work that is being undertaken

under the ASLP. Dr Afzal was also briefed about the site selection for the greenhouse at the NARC. Dr Afzal has been asked to arrange for the inauguration of the site for the greenhouse.

- **14 Jan 11** - A meeting was held with staff from FSC&RD based in Islamabad. Mr Mohammad Haider made a PowerPoint presentation about the nursery registration scheme of Pakistan. FSC&RD administers a series of geographically dispersed germplasm units (GPUs) and is involved in their future development
- **15 Jan 11** – Dr Khurshid visited Dr Hafeez’s research trial sites in NARC to inspect the Australian germplasm and pruning trials. Dr Hafeez has grafted 4 scions on 28th September 2010 the Australian material sent to him in early September 2010.
- **16 Jan 11** - I spent a day in the TV station at NARC Islamabad working on the script and recording for the program on crop management in citrus. I appeared in the TV program. I have been asked question about the ASLP citrus program and technical questions about crop management. The program was aired a week after I left for Australia.
- **5-9 Apr 11** - Dr Iftikhar Ahmad (Chairman PARC), Dr Shazia Ahmad (Plant pathologist) and Dr Munawar Kazmi (ASLP Officer from Australian High Commission) visited Australia. The visitors were exposed to the citrus industry in Australia. During the trip visitors were taken to the Citrus Board, grower’s properties and nurseries. The visitors also participated in the project progress and planning meeting at Dareton. Dr Khurshid produced three videos on crop management during this trip.
- **5-7 Sep 11** - Dr Iqrar Khan (VC UAF) visited Dareton for the citrus industry exposure trip in Australia. Dr Iqrar Khan is a citrus expert and his university is collaborating in the nursery component of this project. Dr Iqrar Khan visited citrus nursery in Mildura and emphasised on the potting media for nursery trees. Dr Iqrar Khan was shown the research facilities and research trials at Dareton. Dr Iqrar Khan took a keen interest in the citrus reworking technique and since then reworking technique has been introduced in Pakistan.
- **21 Oct 11** - A meeting and workshop was held at the University of Agriculture, Faisalabad. Growers from both Punjab and KP were invited along with a few nurserymen. Citrus collaborators were also present in the workshop. Dr Iftikhar Ahmad chaired the session. Dr Tahir Khurshid made a PowerPoint presentation about the Australian citrus industry research focussing on Pakistan; while Mary Cannard (Industry Development Officer) from Murray Valley citrus Board, Mildura did a PowerPoint presentation about the extension system, structure and function of the Australian citrus industry and how such system can be possibly established in Pakistan. Two Pakistani growers, Mr Nobat Khan (KP) and Mr Hamid Waraich (Punjab) also did PowerPoint presentations which addressed the issues of Pakistani citrus industry. The growers emphasised that how ASLP program can be helpful in addressing some of the issues. The presentation session was followed up with the general discussion among growers, collaborates and the Australian experts.

- **22 Oct 11** – Pruning sites and High pressurised Irrigation sites visited and inspected. The newly built screen house was also visited. An existing high density trial at CRI was also visited and staffs were trained in data collection and fruit growth measurements.
- **23 Oct 11** – A full day project planning meeting at UAF which was attended by the project collaborators.
- **25 Oct 11** – Meeting with Captain Arif Nadeem (Secretary Agriculture, Punjab) in Lahore. Dr Tahir Khurshid and Mary Cannard did the PowerPoint presentations about the project progress.
- **25 Oct 11** – Meeting with Mr Asif Khan (DG-FVDP) in Lahore about the coordination of FFS activities with the project activities was held at Awari hotel in Lahore. The discussions were also held about the FVDP web site in interaction with the ACIAR citrus project.
- **27 Oct 11** – Meeting with Chairman PARC, Islamabad. Chairman was briefed about the ongoing project activities.
- **29 Oct 11** - A meeting was held with staff from FSC&RD based in Islamabad. The Director General, Mr Mohammad Nasir and Mr Iftikhar Haider Deputy Director were present at the meeting.
- **30 Oct 11** - Dr Khurshid visited Dr Hafeez's research sites in NARC to inspect the Australian germplasm. I inspected one-year-old material that Dr Hafeez had grafted from Australian material on the 28th September 2010.
- **11 Jan 12** - ASLP Citrus project equipment and new germplasm was exhibited at CRI during an annual citrus show. Project field officers organised the project stall.
- **12 Jan 12** – Abdul Rahman delivered lecture titled “Cost-effective & environment friendly orchard floor management” to in-service trainee's class of 14 district officers at the Agriculture Training Institute (ATI), Sargodha.
- **13 Jan 12** - CRI staff and project coordinator participated in a meeting with the Australian Policy team.
- **12 Jan 12** – Mr Altaf-ur-Rahman delivered a presentation on “Different Management aspects of orchard management as affecting yield and citrus fruit quality” to citrus growers from different citrus growing areas at CRI, Sargodha during Annual Citrus show (600).
- **21 Feb 12** - Meeting with DG, FSC&RD was held in Islamabad regarding characterization, indexation of new germplasm. Progressive nurserymen for future collaboration were also identified.
- **21 Apr 12** – Project progress discussions were held with Pakistani collaborators at Dareton.
- **25 Apr 12** – Visit to MFC and Seven field orchards was carried out and reworking training was given by Graeme Sanderson.
- **26 Apr 12** – Australian and Pakistan citrus team participated in 2 days workshop with social science project at Canberra
- **27 Apr 12** – Australian and Pakistan citrus team participated in 2 days workshop with social science project at the University of Canberra.

- **4 May 12** – Budwood of 7 different mandarin and orange varieties were distributed to the nurserymen and project collaborators. Project progress meeting the Agriculture Secretary Punjab. Progress was presented by Dr Tahir Khurshid as a PowerPoint followed by a discussion with the participants.
- **5 May 12** - Project progress regarding nursery component was discussed with Dr Jaffar Jaskani. The final arrangements for the citrus grower's conferences were inspected. A meeting about the citrus project was held with the Agriculture Secretary Punjab. Progress was presented as a PowerPoint followed by a discussion with the participants.
- **5 May 12** – Climate change in Citrus presentation by Dr Tahir Khurshid to UAF staff and students.
- **6 May 12** – FFS visit at Mr Ilyas Warraich property for high density planting system and pressurised irrigation system.
- **9 May 12** – Citrus growers conference was organised and conducted by ASLP Citrus project (200)
- **10 May 12** - Citrus growers conference organised and conducted by ASLP Citrus project (150)
- **13 May 2012** – Climate change with regards to citrus phenological stages was presented by Dr Tahir Khurshid at Fatima Jinnah Woman University, Rawalpindi (200)
- **17 May 12** – The following presentation were made by Dr Tahir Khurshid to the staff and students at Citrus research institute, Beibei, Chongqing, PR China (150)
 1. Fruit thinning to enhance fruit size in sweet oranges
 2. Climate change effect in citrus with reference to different phenological stages
 3. Effect of Chinese rootstocks on yield and quality of citrus crop
- **16-18 August 12** – A meeting was held with the social science project team (John Spriggs, Barbara Chambers, Sandra Heaney-Mustafa and Rob Fitzgerald) at Dareton
- **11 Sep 12** - Project visit to Mr Ilyas property. Meeting with 4B irrigation engineers, Mr Nasir Jamal for designing the irrigation system at the grower's property. We also invited Mr Sheikh Mahmood from Jaffar Brothers to design the system at Mr Ilyas property and provide us with quotes.
- **11 Sep 12** – Mr Jeremy Giddings delivered a workshop on soil profile and irrigation system to scientist and extension officer at CRI Sargodha. The workshop included hands-on procedure for installation of Tensiometers (30)
- **12 Sep 12** – A collaborative meeting was held at the University of Faisalabad for annual planning. Collaborators from different institutes attend the meeting. Various issues such as senator visit to CRI, performance indicators, irrigation training, newsletter, and research and growers trials were discussed in the meeting.

- **13 Sep 12** – Dr Tahir Khurshid and Dr Munawar Kazmi had a meeting with Ms Erum Rabanni from Coffey International. The scholarship program was discussed during the meeting. Dr Munawar Kazmi requested Ms Rabanni to organise IELTS classes for 3 students who have recently secured JAFs at the Australian universities.
- **14 Sep 12** – Dr Tahir Khurshid visited the screenhouse of NARC and inspected the Australian germplasm.
- **14 Sep 2012** – Dr Tahir Khurshid had a meeting with Dr Hafeez-ur-Rehman and discusses the project progress and issues related to the project.
- **14 Sep 2012** – Dr Tahir Khurshid and Mr Steven Falivene had a meeting with Dr Azeem (social project) and his team Mr Nadeem and Ms Sajida at NARC.
- **18 Sep 12** – Dr Tahir Khurshid and Steven Falivene attended an ICT workshop in the University of Canberra. The workshop was delivered by Rob Fitzgerald (Social project).
- **19 Sep 12** – Dr Tahir Khurshid delivered an annual project progress as a PowerPoint presentation in Canberra. Dr Tahir Khurshid and Steven Falivene attended a workshop on security training for Pakistan travel at the University of Canberra. The workshop was useful; however the citrus team is already following full protocol for each Pakistan visit.
- **20 Sep 12** – Dr Tahir Khurshid attended an ACIAR workshop. The workshop included pathways out of poverty, individual team presentation, AusAid updates and reporting against CAPF.
- **2 Dec 12** – Dr Tahir Khurshid visited ARI, Tarnab. Dr Khurshid met the project team at Tarnab and discussed the project progress. During the meeting the Urdu version of the phenology poster was discussed and finalised. A field trip was followed by the experimental site visit at Tarnab.
- **3 Dec 12** – An annual agriculture show was held at Tarnab and was attended by the Chief Guest Hon. Amir Ahmad Khan Hoti (Chief Minister, KP). An ASLP citrus display was arranged for the field day and the Australian germplasm was showcased during the meeting. The chief minister also visited the newly built screenhouse with the help of project funds.
- **15 Dec 12** – Dr Tahir Khurshid visited ARI, Tarnab (KP) with Dr Abdul Samad (DG Tarnab) and Mr Nisar Naeem (Project officer) and Dr Ghulam Nabi. Meteorological station for the heat unit mapping work was inspected. The meteorological station needs repairing and Tahir agree to provide funds for the repair. Tahir provided the team with 1 set of Tiny tag and probe and 2 sets to Tauseef Tahir. Wajid agree to install one set at the Pali Sherkhana site.
- **16 Dec 12** – Dr Tahir Khurshid visited KP Agriculture University Peshawar. Tahir was accompanied by Dr Ghulam Nabi and met the staff from the horticulture department. The horticulture department were interested to collaborate with citrus project and they wanted to involve more students in the project. Later Tahir visited the chief editor of Sarhad Journal of Agriculture. Tahir is a member of the refereeing committee for this journal. The vice chancellor invited Dr Khurshid for lunch and appreciated the linkages with

ASLP citrus project. Under these linkages Dr Khurshid has examined 7 PhD theses for the university as an overseas examiner.

- **18 Dec 12** – Dr Tahir Khurshid visited Dr Iftikhar Ahmad (Chairman of PARC). Dr Tahir Khurshid participated in national agriculture workshop at NARC Islamabad which was organised by FAO. Dr Khurshid visited the citrus display and interacted with growers from different provinces during the program.
- **15 Feb 13** – Dr Tahir Khurshid, Mr Steven Falivene and Dr Munawar Kazmi visited Mr Azmat Ali Ranja (agriculture secretary Punjab). Dr Tahir Khurshid presented the project progress as a PowerPoint presentation. The secretary appreciated the work being carried out in the citrus project. The secretary suggested the establishment of model farms at the village levels to improve the livelihood of unprivileged growers.
- **15 Feb 13** – Dr Tahir Khurshid, Mr Steven Falivene visited Lahore fruit markets market. During the meeting we met the Market manager and his staff. We learnt about the market system and gained knowledge about the price structure for fruit of different grades.
- **15 Feb 13** – Dr Tahir Khurshid, Mr Steven Falivene and Dr Munawar Kazmi had a meeting with Mr Saadat Ijaz (CEO Roshan Enterprises). The meeting was arranged to discuss the possibility of quality payment system. Mr Ijaz supported the idea of quality payment system. He also emphasises for some work need to be done in quality standards and citrus market research.
- **15 Feb 13** – Dr Tahir Khurshid, Mr Steven Falivene and Dr Munawar Kazmi arranged a meeting with Mr Qazi Adeel Javaid (Senior manager Horticulturist) and Mr Zia Mohammad of Metro. Metro is a supermarket chains in Pakistan, just like Big W or Kmart in Australia. There are 10 stores operating in Pakistan. The idea of quality payment system was supported by both officers.
- **16 Feb 13** – Dr Tahir Khurshid and Steven Falivene attended and breakfast meeting with Mr Mohammad Imran Saeed Khan who is working with AusTrade. Mr Khan discussed the import of fruit to Pakistan from Thailand and Australia. He would like the ASLP Citrus to be involved in nursery component and displaying the nursery product in AusTrade exhibition in Lahore.
- **16 Feb 13** – Dr Tahir Khurshid and Steven visited CRI, Sargodha. We visited the trial sites and inspected the fruit on trees. The fruit appeared to be free from blemish compared to some fruit we inspected in commercial orchards on our way to CRI. We also visited the trial sites of furrow irrigation ('Kinnow') opposite to the pressurised irrigation system. The pressurised irrigation system was also inspected. New trees have now been planted in drip irrigation system among mature trees.
- **17 Feb 13** – Steven Falivene spent the day with project officers Wajid and Tauseef on preparing brochures, videos and Ag-facts. Dr Tahir Khurshid spent the day preparing phenology presentation.
- **18 Feb 13** – Trial harvest was commenced with assistance of Tauseef Tahir, Wajid Ali and Ahmad Raza at CRI Sargodha. Ahmad Raza also continued to harvest fruit on 19 February. A grower harvest forum was organised. The forum included pickers, harvest contractor, growers, scientist and a few

extension workers. A hands-on demonstration on harvest was given to the participants. The harvest forum generated a lot of interest and the issue of quality payment was also discussed. During the forum a few participants showed interest to participate in the quality payment system trial as given below.

1. Asad Razzan
2. Muhammad Yunis
3. Malik Masood Akhtar- commission agent main market Sargodha

- **18 Feb 13** – Dr Tahir Khurshid and the project team from CRI visited the local Sargodha markets. The fruit market was 5 km away from CRI. It was a small market and fruit was bound for the domestic market. The commission agents and contractors took interest in our visit to their market and we learnt about the local market system.
- **22 Feb 13** – Dr Tahir Khurshid and Mr Steven Falivene visited Mr Ilyas property and inspected the trial sites. New irrigation system which was partially completed at the time was also visited. A meeting was held with Mr Ilyas and staff of FVDP on how to conduct the field site demonstration for the mid-term review. It was decided that a FFS will be arranged on the day and a number of posters on project work will be displayed. I suggested having copies of all written material such as posters and brochures should be presented to the reviewers. Mr Wajid Ali will prepare a pictorial album for the reviewers about ARI work since reviewers would not be able to visit KP.
- **21 Feb 13** – A full day collaborative annual planning meeting was held at the University of Faisalabad. Meeting was attended by Dr Iftikhar Ahmad (Chairman PARC), Dr Shazia Ahmad (Assistant Professor), Dr Iqrar Ahmad (VC UAF) and Dr Azeem (Project leader, Social project), and all collaborators from various institutes. Apart from annual planning, a range of issues were discussed during the meeting.
- **22 Feb 13** – A lecture on citrus nutrition was delivered by Steven Falivene was at the University of Faisalabad. Mr Steven Falivene also did a hands-on reworking and pruning demonstration to the nurserymen and postgraduate student at the University of Faisalabad.
- **24 Feb 13** – Dr Tahir Khurshid and Mr Steven Falivene spent a full day with the social project team. Mr Nadeem made a PowerPoint presentation about the base line survey and other work being conducted at the integrated site. Social scientists agree to work on the water distribution of the community on a village level for the furrow irrigation system. The social team also agree to work with the citrus team on quality payment system. Dr Azeem was of the view to add more integrated sited and the citrus project eventually agrees to it after some hesitation in the beginning.
- **25 Feb 13** – A meeting with UNIDO was organised at the Serena Business Complex, Islamabad. Dr Tahir Khurshid briefed the citrus project objectives and activities. UNIDO agree to work with the ASLP citrus project and was happy to put ASLP Citrus AusAid logo in the combined work.
- **26 Feb 13** – Dr Khurshid visited Dr Hafeez's research trial sites in NARC to inspect the Australian germplasm. Dr Hafeez has grafted 4 scions on 28th September 2010 the Australian material sent to him in early September 2010.

Dr Munawar Kazmi, Dr Tahir Khurshid and Mr Steven Falivene discussed the arrangements for the mid-term review with Dr Hafeez-ur-Rehman.

- **28 Feb 13** – Dr Tahir Khurshid and Mr Steven Falivene visited the Thanathon orchards, Fang Chiang Mai, Thailand. Mr Bintoon (owner) took us around his mega orchard in Fang valley and we were quite impressed by the size of citrus operation in Fang. Mr Bintoon offered his orchards and hostel for the future training for the Pakistan staff.
- **1 Mar 13** – Dr Tahir Khurshid made a Power Point presentation on the “Climatic change effect on citrus crop” to the staff and postgraduate of Maejo University, Chiang Mai, Thailand.
- **3 Apr 13** – Dr Tahir Khurshid, Mr Steven Falivene and Nerida Donovan participated in the mid-term review meetings in ACIAR, Canberra. Dr Tahir Khurshid made a detailed presentation of the project progress, while Nerida briefly talked about the nursery training under Ag. Capability program. Dr Tahir Khurshid was satisfied with project work for the last two years.
- **11 Apr 13** – Mid-term review was carried out in Pakistan. The Pakistan citrus team made presentation on the first day of review followed by a field session. The field session included a visit to a screen house and nursery of NARC, a visit to the Mr Illyas property and a visit to the commercial nursery in Sargodha. Both reviewers were quite satisfied with the progress been made by the citrus team.
- **3 Oct 13** – Dr Tahir Khurshid, Dr Nerida Donovan, Dr Iftikhar Ahmad and Dr Hafeez-ur-Rahman met the Federal Agriculture Secretary Mr Seerat Asghar. Dr Khurshid briefed the project progress to the Federal Secretary. Mr Seerat Asghar appreciated the effort of the Australia team and Pakistan collaborators. He emphasised the need for seedless 'Kinnow' and work on the supply chain of citrus. Dr Khurshid emphasised that Mr Seerat Ashagr should visit Australia and meet the Australian Federal government about the ASLP project progress and the continuation of the program for another 4 years.
- **3 Oct 13** – Dr Tahir Khurshid and Steven Falivene had a meeting with Wajid Ali, Tauseef Tahir, and Nisar Naeem about the general project progress and about the progress of KP province. The Australian team is not allowed to travel to KP, therefore, we met with Mr Wajid Ali and Mr Nisar Naeem at the Sareena Hotel, Islamabad. The KP component was discussed and it was decided that Wajid Ali will conduct pruning and quality payment field days in different parts of citrus growing area in KP. The field days will be carried out in Charsada and Nowshera. Tauseef Tahir has to install to a temperature data logger at Mr Illyas property in Sargodha. Wajid will also continue to work with nurseryman about chip budding.
- **3 Oct 13** – The collaborators of KP, NARC and staff from social project team were invited for a project dinner at Sareena hotel Islamabad. Dr Iftikhar Ahmad (in-country project leader) chaired the dinner and briefed the project activities to invited guests.
- **5 Oct 13** – Dr Tahir Khurshid, Dr Nerida Donovan, Mr Jason Bowes and Dr Munawar Kazmi visited the collaborative grower's property SB83 in Sargodha. The visit was organised by Mr Asif Khan (Director, Fruit and Vegetable Development Project). We visited the quality payment orchard on his

property. The fruit load was low to medium. Dr Donovan and Jason identified the nutrition deficiency in citrus trees. Some trees were experiencing Iron deficiency and possibly stressed from salt toxicity. Nerida also found leaf miner and greasy spot problem in the quality payment orchard.

- **5 Oct 13** – Dr Tahir Khurshid, Dr Nerida Donovan, Mr Jason Bowes visited a semi-commercial nursery which is run by professor from Sargodha University. He has planted 11000 low seeded 'Kinnow' on 'Rough Lemon' rootstock. Low seeded budwood was taken from the germplasm unit at CRI Sargodha. Dr Khurshid had reservations about the low seeded 'Kinnow' budwood which was supplied to the nursery without any legal agreement. There is a danger that the university will claim this to be their development.
- **5 Oct 13** – A new citrus property of Mr Malik Atif Ali Awan was visited at SB 47. This grower is our new collaborative grower. The growers had 80 acres of citrus planted and he has established the high density planting (HDP) under the project. Cauliflower crop has been used as an intercrop in HDP. The HDP was planted in September 2013. Tree density was 172 trees/acre. The grower also has a new citrus site right across HDP. This citrus plantation was intercropped with sugar cane and citrus. Grower believes that this is a very good practice and once sugar cane is harvested in December, citrus trees will look good. I decided to inspect those trees on my next visit in April 2014.
- **6 Oct 13** – A detailed visit of CRI research trials was carried out by Dr Khurshid, Dr Donovan and Mr Jason Bowes. CRI staff involved in different components of the project interacted with us and took us to the trial site. The new greenhouse was visited by Nerida for the first time. CRI staff improved nutrient management on nursery trees since the last visit and the trees were now looking much healthier than previous. Nerida had Biosecurity concerns due to regular visits by nurserymen into the greenhouse. CRI were requested to restrict movement of nurserymen and other people into the greenhouse.

Furrow and pressurised irrigation trails were also inspected. Dr Zaka applied 13 irrigations to the flood site, and 19 irrigations to the furrow site between January-September 2013. The current recommendation to irrigate trial sites is when Tensiometers reached 40 kpa (kilopascals, unit used for measuring pressure).

The Pruning site was visited and it appeared that there were some differences in fruit size between the control and treated trees. Detailed fruit size measurements and fruit yield measurements will be taken for quantitative data.

- **8 Oct 13** – Dr Tahir Khurshid, Dr Nerida Donovan, Mr Jason Bowes and Dr Munawar Kazmi visited Dr Iqrar Khan, the Vice Chancellor of UAF. Dr Khurshid presented project progress to the Dr Iqrar Khan. Dr Khan appreciated the efforts of the Australian government and emphasised on the development of clean nurseries. Dr Iqrar Khan also suggested having a citrus conference at UAF towards the end of this project.
- **10 Oct 13** – Dr Tahir Khurshid, Dr Nerida Donovan, Mr Jason Bowes and Dr Munawar Kazmi visited the agriculture secretary Punjab Dr Ijaz Munir in Lahore. Dr Tahir Khurshid presented the project progress of Punjab via

PowerPoint. Dr Ijaz Munir expressed his desire for the project to have more interaction with citrus growers. He also questioned that how the technical knowledge provided by the Australian will continue to be delivered after the project has finished.

- **10 Oct 13** – Dr Tahir Khurshid, Dr Nerida Donovan, Mr Jason Bowes and Dr Munawar Kazmi visited Star Farms Lahore. The team met Mr Farukh Azeem (Manager Business Development) and Mr Syed Shaukat Ali (MD Satr Farms). Mr Farukh Azeem presented a detailed PowerPoint about their work in terms of training and extension of growers. He also presented their work on consumer based traceability system and market capacity building activity for the selected products. Dr Khurshid provided a briefing on current ASLP citrus work in Pakistan.
- **10 Oct 13** – Dr Tahir Khurshid and Dr Nerida Donovan conducted a wrap up meeting in the hotel lobby. We discussed the following topics in detail.
 1. Social science visit to Pakistan 25-27 February 2014.
 2. Nursery component
 3. Nursery training in Dubai or Thailand Sep/Oct 2014
 4. Nursery training for Ag. Capability part 2
 5. Bellamy navel trials at Dareton (Tahir and Nerida)
 6. IHC conference in Brisbane and paper presentations
 7. Increase in project officer's salary
- **28 Jan – 10 Feb 14** – Mr. Steven Falivene Visited the Pakistan to develop certain videos on technologies (Pruning & Top Working) Fact Sheets and also to visit the packing houses in Sargodha region.
- **11 Feb 14** – Dr Tahir Khurshid, Dr Nerida Donovan and Steven Falivene had a combined meeting about the trial harvest at Mr Ilyas property and at CRI. Discussions were also finalised about the packing shed audits. Tahir and Nerida watched the video and suggested some changes. It was decided that Steven will edit and finalise a video on packing shed audit and view it to Peter Tavener (Australian packing house expert). Tahir Khurshid visited Peter Tavener on 2 May 2014 to discuss the video and the proposed scoping study for the citrus supply chain project. Video production for nursery and crop management was also discussed.
- **12 Feb 14** – Video at Al-Imran nursery was filmed by Steven Falivene and Tahir Khurshid. Mr Afzaal visited Australia for nursery training in 2012. He has now established a greenhouse and using potting media to grow citrus trees in his nursery.
- **12 Feb 14** – 'Kinnow' fruit harvest at CRI trial sites was carried out by Tahir, Steven and Nerida. CRI staff helped to arrange pickers. Tauseef Tahir and Wajid Ali supervised tree harvest of experimental trials. Trees were harvested and total tree fruit weight was recorded. Sample fruit size was also measured.
- **13 Feb 14** – Annual planning meeting with citrus collaborators was held at the University of Agriculture, Faisalabad. Each collaborator presented their project progress. Dr Tahir Khurshid Chaired the meeting. Agriculture

Research Institute is making the best progress in terms of experimental program and extension activities. Fruit and Vegetable development project has established 4 Farmer Field Schools at grower's properties of 5 acre each. FVDP was able to send 42 SMS messages about crop management to more than 1155 growers. 4 TV programs have been telecasted 3 times by FVDP regarding crop management practices. There were 20 radio talks completed by FVDP staff.

Other agenda items such as IHC conference (Aug 2014), training packages, nursery training overseas (Sep/Oct 2014), Growers visit to Australia, Irrigation training (Apr 2014) and quality payment system were also discussed. Experimental program from the next year was also finalised.

- **14 Feb 14** – The new FFS property of Malik Atif Ali was visited by Dr Tahir Khurshid, Dr Nerida Donovan and Mr Steven Falivene. We had discussion with Mr Malik Atif about the quality payment system. We decide to help them with fertilisers and pesticides
- **15 Feb 14** – Wrap up project meeting was held at Pearl Continental Hotel Lahore. Dr Khurshid, Dr Donovan and Steven Falivene participated in the meeting. General project progress was discussed. Dr Khurshid emphasised on the need to complete the training packages as the time is running out and we need to complete the training packages.
- **18 Feb 14** - Annual review meeting was held at Islamabad which was attended by all project collaborators.
- **10 Apr 14** – Dr Tahir Khurshid and Mr Jeremy Giddings visited citrus and mango orchards in Multan. Observations indicated that citrus orchards needed improved pruning and nutrition management practices. The project is currently not working in this region; however, it may be included in future projects. Mango orchards were in flowering at this area.
- **12 Apr 14** – Dr Tahir Khurshid and Mr Jeremy Giddings visited mango orchards in Hyderabad region. That was using drip irrigation. Jeremy recommended some improved irrigation practices regarding hours of irrigation during one shift. The grower was also provided with a tensiometer.
- **9-25 Aug 2014** – 15 participants Visited the Australia for 29th International Horticultural Congress (IHC) Brisbane, 2014 & Trainings at NSW DPI Australia.
- **28 Oct 14** – CRI research staff had a meeting with ASLP Social Project Team at the community centre (Village # 83SB Sargodha). The social components were discussed with the citrus staff.
- **Nov 14** - Dr. Sandra Heaney-Mustafa visited 83 SB, Sargodha she also took detail briefing on activities in CRI, Sargodha.
- **6-11 Jan 15** – Australian Delegation (Dr. Tahir Khurshid, Mr. Steven Falivene, Gerard McEvelly & Mr. Sohail Mazhar visited the ASLP Citrus demonstration sites and checked the quality of fruit along with harvesting. The delegation performed several activities during the trip.
 1. Visited CRI, Sargodha on and supervised harvesting of 'Kinnow' from trial plants (6 Jan 2015)

2. Visit to QPS Sites at Village # 83SB, 91SB Sargodha & 04 SB Bhalwal (6-7 Jan 2015)
 3. Visit to Farhad Enterprises and Roshan Enterprises (8 Jan 2015)
 4. Focal group discussion of citrus consumers (Scoping Study) (7 Jan 2015)
 5. Citrus Industry Forum (Scoping Study) (9 Jan 2015)
 6. Diseased fruit sampling and preservation (6-9 Jan-2015)
 7. Pruning Video editing and finalization (9-10 Jan 2015)
- **10 Jan 15** - Annual Planning Meeting was conducted at Serena Faisalabad by UAF chaired by Project Leader (Dr. Tahir Khurshid)
 - **2 Mar 15** – ASLP Annual Review Planning Meeting at Serena Islamabad was attended by all collaborators.
 - **17 Apr – 10 May 15** – Group of 19 People (Researchers, Farmers, Nursery men, women, postgraduate Students and Project Staff) Visited Australia for Crop Management Trainings and improved Citrus Industry exposure.

Other visits: (communications)

- **20 Mar 13** - Mr Peter Heyward the Australian High Commissioner (Pakistan) the screenhouse and Foundation block of UAF, where Australian germplasm was established.
- **21 Mar 13** - Citrus growers from Peshawar visited the screenhouse and were briefed about different activities on at ARI (Participants: 24).
- **2 Apr 13** - Mr Jahangir Khan Tareen, minister for agriculture visited screenhouse at ARI Tarnab, Peshawar. Minister was brief about the project progress.
- **21 Apr 13** - Visit of Mid Term Reviewers (MTR) of ASLP Projects to UAF (Participants: 34).
- **17 Apr 13** – Twenty citrus growers visited screenhouse and citrus orchards ARI Tarnab Peshawar and they were briefed about ASLP citrus activities.
- **9 May 13** - Field assistant for agricultural training institute (ATI) Peshawar visited screenhouse and they were briefed about ASLP citrus activities.
- **21 May 13** - Growers visited the screenhouse at ARI Tarnab and they were briefed about ASLP citrus project activities.
- **22 May 13** - District Management Group (DMG) Officers from different parts of the country visited the screen house and were briefed about citrus activities regarding irrigation, varietal trials.
- **4 Jul 13** - DG, (Environment) Capital Development Authority and DG NARC visited the ASLP citrus screenhouse. They inspected the young trees growing in the screenhouse.
- **9 Jul 13** - Mr Awais Ahmad Laghari (MNA) along with DG, NARC visited ASLP Screenhouse at NARC.
- **15 Jul 13** - Malik M. Ashraf Awan DG, Agency for Barani Area Development along with DG, NARC visited screenhouse at NARC.
- **25 Jul 13** - Visit of the Secretary Agric. Khyber Pakhtunkhwa Muhammad Humayun Khan visited to screenhouse at ARI.

- **2 Sep 13** - Visit of the Minister for Agric. Khyber Pakhtunkhwa Mr. Shehram Khan Tarakai to greenhouse at ARI.
- **12 Sep 13** - The Federal Minister, Mr. Sikander Hayat Bosan, Secretary Seerat Asghar Jaura, Ministry of National Food Security and Research and Mr Syed Muhammad Nasir Ali (DG, FSC&RD) along with Chairman PARC and DG NARC visited the greenhouse of ASLP Citrus Project at NARC.
- **17 Sep 13** - Joint working Group (JWG) of Pakistan-Nepal members from Nepal visited ASLP Citrus project screen-house at NARC.
- **2 Nov 13** - Visit of the Project Leader (ASLP Citrus Project P-II) Dr. Tahir Khurshid to screen house, ARI Tarnab, Peshawar.
- **2 Nov 13** - Visit of the Project Leader (ASLP Citrus Project P-II) Dr. Tahir Khurshid to quality payment system site Akorra Khattak.
- **4 Nov 13** - Visit of the Project Leader (ASLP Citrus project P-II) Dr. Tahir Khurshid to KPK Agricultural University, Peshawar, for presentations on Climate change and heat unit mapping for citrus.
- **19 Nov 13** - Visit of the Project Leader (ASLP Citrus Project P-II) Dr. Tahir Khurshid to quality payment system site Ghaladher, Mardan. Tahir had a meeting with grower Nobat Khan and he also inspected the quality payment site.
- **21 Nov 13** - Visit of the students from Horticulture Department, Agricultural University Mardan to the greenhouse.
- **17 Dec 13** - Visit of the US Ambassador “Richard Olson” to Screen house and Foundation block of citrus at UAF.
- **28 Dec 13** - Visit of the selected growers from Pakistan invited by PARD in Farmer’s Convention to greenhouse, ARI Tarnab, Peshawar.
- **18 Feb 14** – Visit of Dr Tahir Khurshid and Dr Nerida Donovan to the Australia Embassy to meet the ambassador Mr John Williams in Lao PDR.
- **17 Mar 14** - Mr. John Oakeshott (Horticulture Manager Philippines-ACIAR) and Munawar Raza Kazmi (Program Officer – ACIAR, Australian High Commission) visited Field and Screen-house of ASLP Citrus project.
- **27 Jun 14** - Visit of Mr Shaukat Yousafzai, Secretary Agriculture, Khyber Pakhtunkhwa to greenhouse, Agricultural Research Institute Tarnab, Peshawar. He was informed about the citrus activities in the greenhouse.
- **11 Dec 14** - Visit of Mr Yaseen Khalil, Minister Provincial Assembly to Screen House, Agricultural Research Institute Tarnab, Peshawar and was briefed regarding citrus Germplasm received from Australia.
- **11-13 Feb 15** - Participated in International Citriculture Conference (BZU Multan) and presented 03 oral presentations on project outcomes and placed a stall of ASLP Citrus Project (UAF).

Media (Radio & TV Talks):

- **20 Jan 11** - Program on crop management in citrus (T Khurshid) was telecasted on Sohni Dharti TV.
- **Three videos** were prepared on high density system, Fertigation system and reworking in Urdu and English languages. The videos have been telecasted on Sohni Dharti TV in Pakistan in 2011.

- **3 Oct 11**- Dr Ghulam Nabi has been involved in the following extension activities. Radio Interview 18 Nov 10 (recorded) and Sursebz Pakistan (Live) 3 Jan 11, 20 July 11, 25 Aug 11, 22 Sep 11, 13 Oct 11
- **9 Feb 12** – Dr Hafeez-ur-Rahman participated in a TV talk (Channel; ATV “Green Farms” in Islamabad on High Density Orchards.
- **24 April 12** - ABC Interview; Australia and Pakistan share citrus knowledge. Interviewed by ABC Rural's Deb O'Callaghan with Dr Tahir Khurshid, Project Leader, NSW DPI's and Dr Munawar Kazmi, ASLP Program Officer, and Graham Lohmeyer Farm manager, Seven Fields orchards, Mildura. (Source: ABC Rural)
- **26 April 12** - ABC Interview; ASLP Citrus project Australia and Pakistan. Interview by Sarah Hall from National Rural News (Daily rural news bulletin, 2UE Sydney) with Dr Tahir Khurshid, NSW DPI's.
- **4 Feb 14** - Radio Talk on FM 101 by Mr. Nisar Naeem about Nursery production.
- **May 14** - Dr. Abdul Samad delivered TV talks on Pashto One TV on citrus orchards management.
- **10 Dec 14** - Radio Talk by Mr. Nisar Naeem on the topic “Orchard Management Practices”.
- **29 Dec 14** - Radio Talk on Deva Radio (voice of America) by Mr. Nisar Naeem on the topic “Orchard Management Practices”.
- **29 Jan 15** - TV & Radio talks on “Improved Orchard Management Practices” in “Dewa Radio” by Mr. Nisar Naeem and Wajid Ali.

Training arranged by ASLP (Participation of Citrus project team):

- **Sep 13** - Attended a **workshop on Communications Skills** for extension development (E-Connect (<http://www.econnect.com.au>) Murree-Pakistan organized by ACIAR for ASLP Collaborators.
- **7 Apr 14** - Irrigation Management Workshop under ASLP Agriculture Capability Component in UAF-Community College, Postgraduate Agricultural Research Station (PARS), Jhang Road, Near Airport – Faisalabad. Participated by the ASLP citrus collaborators and the Agriculture Extension Officer from Khyber Pakhtunkhwa (KP)
- **21 - 23 May 14** - Citrus team (Mr. Akbar Hayat, CRI; Mr. Tauseef Tahir, UAF; Mr. Wajid Ali, ARI and Dr. Hafeez Ur-Rahman, NARC) attended Training workshop on “Assessment of Technologies” organized by ASLP Social Sciences Project at NARC.
- **30 Nov 14** -Workshop on “Project Evaluation” arranged by the ASLP Social Science team at the University of Agriculture, Faisalabad, Punjab. Wajid Ali, Abdul Rehman,
- **3 - 7 Mar 15** - Impact Pathways & Assessment and Evaluation Training for Agricultural Research Projects Workshop in Serena Hotel, Islamabad. (Participants: Tauseef Tahir, Nisar Naeem, Wajid Ali, Abdul Rehman, Dr Hafeez ur Rehman.

Lectures at the Universities and Institutes:

- **28 Oct 11** - Presentation on “Heat Unit Mapping” and “Climatic effects on tree crop” by Dr Tahir Khurshid to the scientific community at NARC, Islamabad (42 scientists and postgraduates participated).
- **12 Sep 12** - Lecture on Irrigation Management of Citrus in Australia by Mr. Jeremy Giddings at UAF. Attended by Research Scientists & Students (Participants: 60)
- **22 Feb 13** - Lecture on “Nutritional Management of Citrus Orchard in Australia” by Mr. Steven Falivene at UAF organised by Dr. Jaffar Jaskani & Tauseef Tahir (Participants: 56)
- **8 Oct 13** – Dr Nerida Donovan delivered a lecture to postgraduate and faculty staff UAF, Faisalabad. Dr Donovan explained the biosecurity system of Australia. She also explained the procedure to import a variety and emphasised on nursery hygiene (Participants: 40)
- **4 Nov 13** - Climate change and heat unit mapping for citrus visit of the Project Leader (ASLP Citrus project P-II) Dr. Tahir Khurshid to KPK Agricultural University, Peshawar (Participants: 257)
- **12 Mar 14** - Lecture on “Tropical Horticulture and Cluster Formation Strategies of Philippines” by Mr. John Oakeshott, Horticultural Manager of ACIAR at UAF (Participants: 253)
- **10 - 12 Apr 15** - Lecture on Citrus Nursery Management and Pruning techniques by Miss Ammara Saeed (PhD student, KP Agricultural University, Peshawar) to Horticulture Nursery Workers, Agricultural University, Peshawar and Student of B.S (Hons) 3rd year From Govt Girls Degree College, Hayatabad, Peshawar.



Ms Mary Cannard (Citrus Industry Development Officer), Australia and Mr Mohammad Ilyas Warraich (Collaborative grower) during lunch break at Farmer Field School, Sargodha