Australian Government

Australian Centre for International Agricultural Research

Final report

project	**Market development for citrus from eastern Indonesia**
project number	SMAR/2007/196
date published	June 2011
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final report number	FR2011-16
ISBN	978 1 921738 91 3

published by

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GPO Box 1571
Canberra ACT 2601
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1 Acknowledgments

We gratefully acknowledge the contributions made by the team members of the project, especially:

- Indonesian contributors; Mr. Ady Cahyono, Mr. Dideik Agung Budianto and Mr. John Sembanu.
- Australian contributors: Mr. Andrew Green, Ms. Nancy Cunningham, Ms. Karolina Steciuk and Mr. Craig Swanburry.

In particular, we would like to acknowledge Dr. Arry Supriyanto for his leadership as Project Coordinator during the first 18 months of the project.

ACIAR provided generous support to this project. The help and advice from staff of the Makassar office was invaluable; especially from Thomas Oberthur, Luthfi Fatah, and Suliyanti Hakim.

Many people in Indonesia were generous in providing assistance and took time to answer the many questions that were posed by the team members.

2 Executive summary

The development of the citrus industry was identified as a priority for several provinces in Eastern Indonesia. An analysis of the Indonesian citrus market and eastern Indonesian supply chain (SMAR/2007/209) identified a highly competitive market with opportunity to improve supply chain management and market penetration on products with identified comparative advantage, particularly keprok (mandarins) from regionally specific locations.

The three regions identified were the SoE area in West Timor (NTT), the coastal area near Jeneponto and Bantaeng in South Sulawesi (Sulsel), and Buton Island in South East Sulawesi (Sultra). Effective development within these regions required a better understand the market potential and supply chain constraints within Indonesia. This is particularly the case, given there are multiple competing sources of citrus, both within and from imported fruit.

The general aim was to improve grower returns through the adoption of improved production and post handling techniques. A specific aim was to provide Eastern Indonesian R&D providers with an increasing the understanding of the citrus supply chain and tools to facilitate cooperation among the different segments. The project began with two objectives at either end of the supply chain, with the aim to connect in the 'middle'.

The 'market end' objective was to introduce and foster market driven practices in the keprok supply chain. Initial assessment of the citrus marketplace involved visits, product testing and discussion with supermarkets, distributors, wet markets, traders and collectors. A report was written by Liz Gunner and Karen Shepherd based on market research and experiences with keprok SoE during this project. The report identifies major hurdles to achieve high volumes of consistent quality into supermarkets. However, several niche opportunities were suggested. In particular, the gift or 'ole ole' markets, and smaller (higher value) retail outlets.

The 'grower/trader end' objectives were to develop on-farm and post-harvest management practices for improved marketing of keprok. Initially, the project introduced quality awareness and identified potential supply chains for keprok from SoE in NTT. The majority of activity was conducted in NTT, where demonstration plots were established to compare traditional and 'good practice' keprok production. At the end of each season, fruit was collected from trees within the demonstration plots and assessed for different quality parameters. BPTP team members from other provinces have been involved in 'quality' activities in NTT to gain 'hands-on' training. Visits were conducted in Sulsel and Sultra in Sulawesi and discussions with local extension workers and community leaders identified some production issues effecting quality and supply of local markets. For instance, on Buton Island growers encourage upward growth by supporting limbs with bamboo poles. This encourages rank, vegetative growth and reduces fruiting. We organised a pruning expert to hold discussions with local growers to develop techniques that best fit the cultural practices of growers. Team members also established demonstration plots in Sulsel and Sultra during the second and third year of the project to introduce keprok quality assessments to growers.

The major 'connecting' activity was the trial shipment of waxed fruit, which involved a regional trader; a key link in the supply chain. The initial project activities reinforced that a good relationship between different partners in the supply chain is important, and an understanding of the roles at each level of the chain is key to achieve this end. For this reason, the trial involved the coordination of a trader, shipping company and supermarkets as a means to demonstrate the whole chain to the team members. The shipment of keprok SoE was monitored by from harvest to retail supermarkets in Surabaya, Java. We introduced gentle harvesting, waxing of fruit, market surveys, cool storage and product assessment at retail outlets to highlight ways to improve efficiencies throughout the supply chain.

The project fostered collaboration between these different provinces, with the interaction between each of the Assessment Institutes for Agricultural Technology (Balai Pengkajian Teknologi Pertanian or BTPT) within the provinces being critical to success.

The impetus to develop new markets is currently weak, but this could quickly change as significant new plantings bear fruit. The next steps require preparing the product, i.e., providing the quality, volumes and consistency for specific markets, and developing the supply chain. This is probably best implemented in small increments by meeting the specifications of low volume or niche markets. In other words, don't create market expectations that you can not fulfil.

Citrus production provides cash income that is used to provide opportunities for the next generation

3 Background

Indonesia, with a population in excess of 220 million is forecast to reach 250 million in the next 10 years, making it a large consumer of food. The population are consuming more fresh foods and the increasingly affluent urban group are more discerning in regard to health, safety and quality of food. This has increased opportunities for modern retailers to expand into fresh foods.

A 2005 AC Nielson study found that while wet markets still dominate fresh food trade there is a trend to shopping at modern outlets particularly for fresh fruits. More than 95% of household shoppers preferred to buy fresh meat, seafood and vegetables at traditional outlets while 21% of the shoppers preferred to buy their fresh fruit purchases at the modern retail outlets. The study found that consumers preferred to buy their fresh fruit purchases at modern outlets due to better displays and preservation systems and better access to imported fresh fruits.

Citrus are an important part of modern retail fresh fruit sales and they usually stock a wide range of local and imported citrus. Although imported citrus account for only 4% of Indonesia's consumption, they are consider prestigious and command higher selling prices. Indonesia's locally produced fruit is distributed in non-refrigerated trucks, which is in stark contrast to the cool chain management of imported fresh fruit. Consequently, local citrus has a short shelf life and is often highly discounted to obtain quick sales.

Citrus production is growing rapidly in Indonesia, with an increase of 400% (from1999-2006) to reach over 2.2 million tonnes. During this period the main growth areas have been in the western provinces of North Sumatra, East Java, South Sumatra and West Kalimantan. Eastern Indonesia accounts for only 12% of citrus production, mostly grown in South Sulawesi.

South Sulawesi is a major citrus growing region (160,000 tonnes). Production is increasing but at a slower rate than the western provinces. Disease is a major issue, and has decimated tree numbers in traditional growing areas in the north of the province. Major replanting is being undertaken, but disease-free certified seedlings are needed to sustainably replace lost production. The major cultivar, siam, is mainly grown in the northern provinces. Selayar Island produces a popular local keprok variety (3,000 tonnes per year).

South East Sulawesi is a minor citrus producing province (22,000 tonnes), but there have been significant new planting in recent years. The major cultivar, siam, is mostly grown on Muna. A keprok in high demand locally is grown on the island of Siumpu. Significant plantings of Siumpu keprok have recently been planted on nearby Buton Island to boost production.

Nusa Tenggara Timur (NTT) is a minor citrus growing province (21,000 tonnes), and there have been some new planting in recent years. A local keprok grown in the SoE area is highly regarded and commands a high price locally. Keprok SoE has been promoted at Jakarta trade shows where it has won best fruit trophies (Morey 2007).

The overall direction of citrus production is high growth, with highest growth in western provinces. This poses a risk to citrus production in Eastern Indonesia, which is increasing production at a time when overall production volumes are shifting from east to west provinces.

Morey (2007) suggested that this rapid growth in production, coupled with increased imported citrus, was likely to place traditional distribution and marketing systems under greater strain, and create hardship for smaller fragmented grower groups and their communities.

The development of the citrus industry was identified as a priority for several provinces in Eastern Indonesia. There was a need to better understand the market potential and supply chain constraints within Indonesia, given there are multiple competing sources of citrus (Morey 2007). In particular, there was an established supply chain strategy for imported citrus that is clearly lacking in the inter-island marketing of local citrus from Eastern Indonesia.

An analysis of the Indonesian citrus market and eastern Indonesian supply chain (Morey 2007) identified a highly competitive market with opportunity to improve supply chain management and market penetration on products with identified comparative advantage, particularly keprok (mandarins) from regionally specific locations.

Due to the comparative advantage of Keprok from SoE, the project initially focused on the development of a supply chain model from SoE in NTT, which was used as a tool for basing latter activities in Sulawesi. The project fostered collaboration between the different provinces, with the interaction between each of the BPTP within the provinces.

The general aim was to improve grower returns through the adoption of improved production and post handling techniques and by increasing the understanding of and cooperation among the different segments of the citrus supply chain. Growers are powerless price takers under the current marketing arrangements of domestic citrus. By further examining the citrus supply chain, identifying potential partners within it and creating a more market and consumer driven focus growers will be better equipped to extract increased benefit for their efforts. This approach focuses on 'the need for greater emphasis on matching production of raw and processed products to market requirements.'[1]

Realising the competitive advantages of keprok required developing awareness of 'quality' parameters, product differentiation and the importance of careful post harvest handling. In the longer term, it also requires fostering market driven business practices in the keprok supply chain, and forging stronger links between farmers and the marketplace. This project builds on earlier work by Wei [2] to assist keprok growers in meeting market requirements.

The project involved the South Australian Research and Development Institute (SARDI), the Citrus Industry Development Board (CIDBSA), Rural Solutions SA, MoreLink Asia Pacific, Indonesian Citrus and Subtropical Fruits Research Institute and Balai Pengkajian Teknologi Pertanian/Assessment Institute for Agricultural Technology (BPTP/AIAT) in each provincial location (NTT, Sulsel and Sultra).

SARDI was responsible for coordinating the post harvest handling and storage aspects of the project, while Rural Solutions SA coordinated analysis of the supply chain, gathered market information and assisted with the dissemination of information to project participants.

[1] 'Matching Products to Markets', Theme 4, Linking farmers to Markets, *ACIAR*

[2] *Dr Sherri Wei,* Improved marketing of mandarins in East Nusa Tenggara in Indonesia and northern Queensland, *ACIAR Project ID ASEM/1999/013*

Objectives

The aim of the project was to identify and develop effective keprok supply chain models for eastern Indonesia that has the capability to compete within the Indonesian domestic citrus market.

Objective 1: To introduce and foster market driven business practices in the keprok supply chain

Activity 1: Initiate project to maximise value of first trip by having Indonesian partners set up meetings.

Activity 2: Project implementation and information gathering. Attend project development workshop and develop a strong understanding of the citrus industry and marketplace to determine who the major players are, how they operate and what they and their customers are looking for in a citrus product.

Activity 3: Information gathering – Indonesian partners. Indonesian partners travel to second agreed marketplace to interview retailers and wholesalers.

Activity 4: Mapping and Analysis. Analyse gathered information. Identify and describe three supply chains and develop framework for supply chain mapping. Investigate drivers of existing and alternative supply chain models

Activity 5: Product testing. Determine technical product specifications of each benchmark product and determine realistic product specifications for keprok with project analysis, market reality and production issues all taken into account.

Activity 6: Dissemination of learnings in Australia. In conjunction with SARDI hosted visit, conduct 'train-the-trainer' style workshop on supply chain management concepts and their application to the Indonesian citrus industry, the keprok in particular.

Activity 7: Recommendations. Documentation of key learnings. Develop realistic short, medium and long-term goals for optimising keprok supply chain, with input from SARDI, Indonesian partners and supply chain champion/s.

Activity 8: Follow-up support. Provide support to Indonesian partners and/or supply chain champions in the dissemination of learnings to growers at the appropriate time.

Strict quality checks on fruit on receivial at modern supermarkets in Java

Objective 2: To develop on-farm crop management practices for improved marketing of keprok.

Activity 1: Demonstrate citrus crop and fruit sizing methods and adapt to keprok.

Activity 2: Demonstrate sugar to acid ratio testing techniques and develop testing regime for keprok.

Objective 3: To develop post harvest crop management practices for improved marketing of keprok.

Activity 1: Conduct work on reduced risk chemicals to sanitise and control postharvest disease on mandarins

Activity 2: Conduct work on determining the importance of maturity in the storage life of mandarins

Activity 3: Demonstration trials on storage life of fruit after applying treatments developed in earlier activities

Dr. Taufiq Ratule conducting quality assessment of keprok SoE from demonstration plots

4 Methodology

Objective 1: To introduce and foster market driven business practices in the keprok supply chain.

Identifying project partners

By identifying the most relevant citrus supply chain participants, the project stands a much better chance of success. These businesses, who can provide valuable information in later stages of the project on supply chain management and preferred product characteristics, could be the supply chain partners in years to come when the keprok is ready for market.

Mapping and analysing existing keprok supply chain

In order to improve or rebuild the existing keprok supply chain, it must be further analysed and understood. By understanding how the supply chain functions, or doesn't, who the key players are and what their role is, the project will be better able to develop the foundations for future supply chain development and management. Also, supply chain champion/s will be identified and encouraged to participate in the project.

Assessing marketplace for citrus

The aim is to work with retailers and wholesalers to get a clear picture of what they and the marketplace (consumers) are looking for in a citrus product. Having a clear understanding of the characteristics of competitor fruit and how they are delivered to market will aid in the development of technical activities being conducted within the project, as it will become clearer the characteristics the keprok and its supply chain will need to be competitive.

Benchmarking keprok against other citrus

A gap analysis between competitor products and the keprok in its existing form will impact on the technical activities required on farm to elevate the kerprok's quality to meet market requirements. Product specifications will be developed for the kerpok with the assistance of a local university's facilities by analysing the characteristics of preferred citrus in the marketplace as identified in the previous activity. Product specifications for the keprok are essential for the development of a product with any genuine opportunity in the marketplace.

Supply chain management workshop with traders and/or extension officers

This activity will disseminate information gathered on the citrus supply chain, generating awareness of alternative business practices and opportunities within the keprok supply chain. It is hoped that in the gathering of information on other supply chain models in early activities, appropriate case studies will be developed of other supply chain success stories, preferably delivered by active participants, to increase a sense of relevance and achievability by workshop attendees.

Review/take stock of project's progress

This step will review the project to date and determine the appropriate steps forward, dependent on earlier progress. It is envisaged; this activity will result in a report.

Objective 2: To develop on-farm crop management practices for improved marketing of keprok.

Linking quality factors to production-based Primatani trials

Local Government extension officers (Dinas) and Balai Pengkajian Teknologi Pertanian (BTPT) have a strong production orientated approach to solving citrus problems, highlighted through the Primatani initiative. Citrus yields are low in many areas, but producing more fruit, without considering quality or marketing value, is not a sound strategy for increasing income in the long term. The Primatani production-based demonstration trial design was used, but select trees were more intensively sampled to assess quality parameters. The quality measurements were used to compare best practice 'production' trials with standard farm practice. Assessments occurred over three seasons in West Timor (Molla Ultara district), two seasons in South (Jeneponto & Bantaeng district) and South East Sulawesi (Wabula district, Buton Island) , and included fruit sizing, colour development, juice content, sugar/acid ratios and taste tests. Detailed descriptions of the methodology can be seen in the regional reports listed in the appendices. Briefly, the main activities were conducted on keprok SoE properties in Ajaobaki, Mollo Utara district. Twelve trees were paired, and one tree from each pair was treated with fertiliser, mulching and extra watering (best practice). Fruit quality data was collected each season. In addition, four larger demonstration plots (60 to 100 paired trees) were established in Ajaobaki to compare traditional practices with best practice. Data of fruit yield was collected each season.

BPTP staff underwent training in crop estimation, fruit sizing and pruning techniques during a visit to citrus-growing areas of Australia. On return, Indonesian growers were introduced to pruning techniques to promote good sized fruit and 'clip harvesting' to retain a healthy calyx during storage. Fruit clippers were supplied to selected growers.

Craig Swanberry(Fruit Doctors) demonstrating the methods used for fruit sizing to BPTP staff, extension officers and growers at Ajaobaki.

Objective 3: To develop post harvest crop management practices for improved marketing of keprok.

Sanitation and disease control workshops

BPTP staff took part in sanitation workshops in Australia. Chemicals used were common food processing aids, such as commercial bleach (sodium hypochlorite) and baking soda (sodium bicarbonate), for sanitation. Staff members were also shown methods used for comparative testing of postharvest treatments. These included;

- Maturity indexing (sugar/acid reduction during storage)
- Snip picked Vs hand picked
- Washed Vs unwashed
- Natural Vs Degreened (ethrel dips or sprays)
- Waxed Vs unwaxed
- Production treatments (fertilised Vs unfertilised fruit)

BPTP staff for Sulawesi returned to conduct comparative trials with local product (see regional reports in appendices for detailed methods used).

Storage life trials

The major activity was the trial shipment of waxed keprok SoE to supermarkets in Java or Bali. Traders, shipping companies and supermarkets were approached to cooperate in the shipment of fruit. This approach identified gaps in the current supply chain, especially in cool storage management. The treatments included waxed and unwaxed keprok Soe transported under cold storage and in ambient conditions. All trial fruit was weighed initially and at point of sales to assess the comparative shelf life of the various treatments. Visual assessment and taste tests were undertaken at point of sale. A sample of waxed keprok SoE was sold along side normal unwax kepork SoE in the local Kupang supermarket, Ramayana. The sale of keprok was monitored and questionnaires developed to assess consumer reaction to the wax product.

The procedures for trials were supplied as worksheets to participating team members. The waxing example is shown below:

Kupang Wax Trial Procedure

This procedure is to be used to at the trader's house to wax keprok before loading onto the vessel for Surabaya. We will send some waxed and some unwaxed keprok in different cartons. The vessel has refrigeration for only 3-5 cartons, depending on the type of vessel. We will place 3-5 cartons (waxed and unwaxed keprok) in refrigeration and another 3-5 cartons (waxed and unwaxed keprok) in a non-refrigeration room. Small netting bags with fruit will be weighed before and after the voyage to compare the weight loss in each storage category. Visual assessment can be conducted at the Surabaya supermarket.

This waxing procedure can also be used for the Trader's keprok to be sent to the Kupang Supermarket for Saturday and Sunday trading.

<u>Equipment</u>

- 100kg good quality keprok (from demonstration plots)
- Wax (supplied from Australia)
- Bucket (5L)
- Dipping basket (supplied from Australia)
- Gloves (supplied from Australia)

- Drying racks
- Fruit netting bags and labels (supplied from Australia)
- Laboratory scales
- Plastic crates for packing keprok (from Ramayama)

Waxing Procedure

1. All keprok checked and sorted into two unequal groups (60:40).
2. The larger group (60%) of keprok will be waxed and placed into 6 crates. The smaller group will not be waxed and will be placed into another 4 crates.
3. The larger group waxing procedure is as follows;
4. Wax is diluted with clean water (50:50) in bucket
5. Place fruit into dipping basket and immerse into dilute wax
6. Allow to drain and place wet fruit on rack to dry
7. After dry, place into plastic crates.
8. Wax enough fruit to fill 6 crates. Label 3 plastic crates 'Waxed; Keep Refrigerated' in English and Indonesian. Label 3 other plastic crates "Waxed: Do Not Refrigerate' in English and Indonesian.
9. The smaller group (40%) of keprok can be placed into 4 remaining plastic crates without waxing. Label 2 plastic crates 'Not Waxed; Keep Refrigerated' in English and Indonesian. Label 2 other plastic crates "Not Waxed: Do Not Refrigerate' in English and Indonesian.

Weighing Procedure

1. Collect 6 fruit from one plastic crate, and use 2 netting bags and labels.
2. Place 3 fruit into each netting bag, then tie the bag ends and secure the label.
3. Weigh each bag of fruit using laboratory scales
4. Record weight of each bag of fruit on the bag's label, and on the record sheet provided.
5. Place labelled fruit bags back into plastic crate and secure.
6. Repeat this bagging and weighing procedure for keprok in the 10 plastic crates (total of 20 labelled bags)

Storage Procedure

1. After the keprok is weighed; the keprok should be stored according to the label directions.
2. All crates are taken to the Ramayama supermarket. The crates labelled 'Keep Refrigerated' are stored in the cool room until they can be loaded into refrigeration room on the vessel. The crates labelled 'Do Not Refrigerate' are stored in non-refrigerated rooms at the supermarket and onboard the vessel.

5 Achievements against activities and outputs/milestones

Objective 1: To introduce and foster market driven business practices in the keprok supply chain.

no.	activity	outputs/ milestones	completion date	comments
1.1	Identification of project partners Project implementation workshop to establish key roles & responsibilities Develop a strong understanding of the citrus industry and this marketplace to determine who the major players are, how they operate and what they and their customers are looking for in a citrus product. Identify and form relationship with supply chain champion eg: Trader &/or Extension Officer/s.	project implementation workshop (Batu) Gather information from project partners. Interview retailers and wholesalers (Surabaya, Jakarta, Makassar & Bali) Conduct market visits(Surabaya, Jakarta, Makassar & Bali) Form relationship with supply chain champion/s. (trader/s and/or extension officer/s.)	Aug Q3	Relationships & project roles and responsibilities formed with BPTP extension officers. Expect to identify suitable trader in a later activity. Internal report using meeting notes with supply chain participants.

Supermarket staff regularly monitor the quality of fresh fruit on display

no.	activity	outputs/ milestones	completion date	comments
1.2	Mapping and analysing existing keprok supply chains. With Indonesian partners' assistance and particpipation, identify and describe three supply chains: Market Leader, Mature citrus supply chain, Current keprok supply chain. Develop framework for supply chain mapping. This framework will enable the assessment of supply chains, highlighting gaps and opportunities.	Comprehensive analysis of all gathered information. Three supply chains identified to provide a practical, realistic picture of citrus industry and the keprok, with two possible benchmarks and an understanding of competitors.	Aug Q3	Three citrus supply chains described: market leader; mature chain; and commodity. The reality is that the keprok Soe supply chain is so ad-hoc, supply driven, and at times non-existent, that comparisons with market leader and mature citrus supply chains serves only as an indicator of how far the keprok Soe chain will need to come. While this in itself is valuable, a mapping framework and supply chain analysis holds little value at this time.
1.3	Assessing marketplace for citrus Product testing Indonesian partners co-ordinate laboratory testing of products representing three above supply chains Work with SARDI to determine realistic product specifications for keprok with project analysis, market reality and production issues all taken into account.	Product specifications for keprok to provide specific, technical benchmark for the product and firm objectives and goals for SARDI's on-farm work.	Aug Q3	Marketplace assessment completed for key markets of Surabaya, Jakarta, Denpassar, Makassar, including wet markets, retail (independent and chain), food service, and wholesale. Product testing undertaken on a range of competitive citrus fruit to assess acid/brix, taste, texture etc. We now have a good understanding of the market requirements for Indonesian citrus, and keprok Soe has a long way to go in terms of product consistency, quality control issues, post harvest handling, logistics, and volumes of supply. Without these basic issues addressed, product and market specifications are unachievable. The keprok Soe has significant ground to cover to achieve market success. Our intention is to analyse this information and disseminate it to our Indonesian partners and supply chain participants. Working with SARDI we hope to develop some of the on-farm activities necessary to address some of the basic production issues in the hope that product specifications can be developed to match market opportunities.

no.	activity	outputs/ milestones	completion date	comments
1.4	Benchmarking keprok against other citrus	Gap analysis between competitor products and the keprok in its existing form. Product specifications will be developed for the keprok	Aug Q3	The marketplace assessments of competitive citrus has provided detailed retailer product specifications, setting a high benchmark for the keprok Soe to achieve. It appears that the keprok Soe is a number of seasons off contemplating a high volume retail opportunity (supermarket). However there are several niche opportunities worth pursuing, providing quality, logistics and supply issues can be addressed.
1.5	Market and Supply chain management workshop. Includes project review and direction setting	Provide focus for the delivery of Objectives 2 and 3. In-depth opportunity for understanding market and supply chain concepts. Empowerment of Indonesian partners to ensure they are equipped to build capacity through the application of learnings in the citrus industry and beyond.	See activity 3.2	Activities re-aligned with SARDI's post-harvest waxed trial activities in the 2009 keprok Soe season. It was decided that a workshop would be the least effective way of building capability with project partners. A more hands-on demonstration style approach is proposed with supply chain participants.
1.6	Review/take stock of project's progress. Documentation of key learnings, in conjunction with Indonesian partners. Develop realistic short, medium and long-term goals for optimising keprok supply chain, with input from SARDI, Indonesian partners and supply chain champion/s.	Report with recommendations for keprok industry development and for further ACIAR project development.	2009 Q4	While the Keprok Soe has potential to be differentiated (eg. colour) there is significant development required at all levels of the supply chain before market opportunities can be pursued. The major broad hurdles preventing immediate market development are a lack of volume until additional trees start bearing fruit; inconsistency in product quality; the unreliable and variable transport options available; the need for a person or group to co-ordinate the supply chain; and some market perceptions on its quality, taste and consistency of supply in the market place beyond Kupang. Overall the situation is this – Keprok has the potential to fill niche market opportunities, but efforts must be made over the coming seasons to improve product quality and consistency and develop a reliable and effective supply chain.

PC = partner country, A = Australia

Objective 2: To develop on-farm crop management practices for improved marketing of keprok

no.	activity	outputs/ milestones	completion date	comments
2.1	Demonstrate citrus crop and fruit sizing methods and adapt to keprok.	Protocol capable of predicting crop and fruit estimates for keprok. Collaborators trained in the crop and fruit size estimate methods.	annual, Q3	Demonstration plots and fruit sizing occurred over 3 seasons in NTT. The keprok trees were part of best practice Primatani, with fruit size and overall tree yield compared. Demonstration plots were established in Sulawesi in the 2nd and 3rd years. Capability established but need to estimate for marketing purposes not required yet (see comments 2.3)
2.2	Demonstrate sugar to acid ratio testing techniques and develop testing regime for keprok.	Protocol capable of developing maturity profiles for keprok cultivars. Collaborators trained in the maturity testing methods	annual, Q3	Demonstration plots and sugar acid ratios occurred over 3 seasons in NTT. The keprok trees were part of best practice Primatani, with brix acid, taste and overall tree yield compared. Demonstration plots were established in Sulawesi in the 2nd and 3rd years. Capability established but drivers to grow to taste not evident yet (see comments 2.3)
2.3	Establish on-farm crop management program for on-going operation	System developed and implemented for ongoing demonstration of methods for crop and quality management	annual, Q3	Demonstration plots and quality measurements occurred over 3 seasons in NTT. Demonstration plots were established in Sulawesi in the 2nd and 3rd years. The emphasis in Sulawesi has been to induce pruning techniques and thinning of fruit to improve fruit size. Growers are paid a premium for big fruit and this is seen as a direct advantage to them. The need to supply to market specifications is not clearly evident to the growers while supply barely meets local demand. There is no clear proponent in the supply chain to actively champion the development of new inter-island markets. The impetus for growers to improve quality management may not occur until young citrus trees bear fruit leading to oversupply.

PC = partner country, A = Australia

Objective 3: To develop post harvest crop management practices for improved marketing of keprok

no.	activity	outputs/ milestones	completion date	comments
3.1	Activity 1: Conduct work on reduced risk chemicals to sanitise and control postharvest disease on mandarins	Safe, effective and inexpensive methods to sanitise and control postharvest disease on citrus. Collaborators trained in sanitation and postharvest disease control methods	2009, Q3	The aim is to reduce postharvest losses to improve returns to growers. However, the collector and trader are the most likely persons to benefit from an extend storage life. The benefits to growers rely on 'trickle down' effects from better prices to trader/retailers. The approach has been to train staff involved in the project sanitation and postharvest disease control methods to suit requirements of Indonesian retailers. This training was conducted in Australia during 2009.
3.2	Activity 2. Conduct work on determining the importance of maturity in the storage life of mandarins	Harvest guidelines and storage guidelines to increase the 'window for marketing'. Trial shipment of keprok SoE into local Kupang supermarket (with consumer survey) and inter island trade (Bali and Surabaya) Collaborators trained in protocols for optimum storage of citrus (Australia).	2010, Q2	Developing maturity parameters has been difficult as many of the current bearing trees are seedlings, with highly variable growth characteristics. The approach was to conduct a trial shipment of keprok SoE as a demonstration of good handling procedures to suit requirements of Indonesian retailers. The approach has been to train staff involved in the project in the methods used for citrus storage trials and visited Australian citrus packers, marketers and retailers. This training was conducted in Australia during 2010.
3.3	Activity 3. Demonstration trials on storage life of fruit after applying treatments developed in earlier activities (in Indonesia).	Appropriate and practical methodologies developed to reduce waste and improve storage life.	2010, Q3	Laboratory trials on storage of keprok were conducted in Sulawesi. The postharvest faculties were rudimentary and sample sizes small. However, the capability for further work of this type has been established in these BPTP staff.

PC = partner country, A = Australia

6 Key results and discussion

The key results are extensively described in the internal reports listed in the appendices, and are summarised below:

Surabaya market visits

Market visits were conducted in Surabaya in 2008. Surabaya is populous city with a busy port with trade to Kupang (West Timor)and Makassar (South Sulawesi). Markets visited included Hokky Pusat Buah, Pasar Penele, Pasar Ahmad Jaya, Pt Godong Segar Abadi, Super Indo Supermarket (Plaza Surabaya), Materhari Hypermarketsogo, Plaza Tanjungan, Jalan Anjasmoro (Street Pasar), Pasar Krampu, Pasar Tambarhargo, Giant Maspion Hypermarket Surabya, Surabaya Sheraton Hotel.

Observations from interviews

- Growers in specific regions were not aware of what's happening in other regions throughout the season. Nor are they aware of what is happening in the market in terms of price and volume. No tools to manage season, harvest and sales. There is an opportunity to improve information flow to give farmers more influence over the product and its path to market.
- No QA system on farm, quality control happens at other end of the chain. Risk is much higher up the chain, and therefore price is reduced to the farmer to compensate. Opportunity to look at ways to pass some responsibility back to the farmer to sort, grade, size, providing the collector/trader is willing to pay more for the service. Also, sorting on-farm is going to give the farmer more knowledge and therefore control over his product (regardless of whether someone pays). However, this also increases the farmer inputs/costs. While it gives more room for negotiation and is an empowerment tool for the farmer, there must be someone willing to pay extra for it to make it worthwhile.
- If farmers recognised they'd be paid more for bigger fruit, they could undertake different farming practices to provide that product as is done in Australia.
- Could test for branding – what will pique an Indonesian shopper's interest to pay more for a product? Brands appear to have considerable influence in Indonesia in other products such as clothes, luggage, accessories etc. Fruit and vegetables are still considered commodities, as they still are largely in Australia.
- Sunpride (local brand) bananas promote and provide nutritional info, fliers and branding (observed in Giant Hypermarket). Handle imported citrus, pears and apples. Is there an opportunity to look at contract growing for local citrus?
- 'Ole ole' (gift) market at airports, particularly Kupang, is an opportunity worth exploring for the Keprok SoE. This is a small, niche opportunity, but could still provide a decent outcome for growers. This could be a small, manageable supply chain pilot.
- Hotels like The Sheraton, seeking unique fruits, and might be interested in a seasonal, high quality Keprok SoE. The need to meet HACCP standards rules it out in the short term.

Jakarta, Makassar & Bali market visits

Market visits were conducted in 2008. Jakarta is populous city with extensive modern retail outlets. Bali has historical links with keprok trade from West Timor. Makassar is a large local market for keprok grown in South Sulawesi. Markets visited included:

- Jakarta; Sogo Plaza Senayan, Hero – Plaza Senayan, Block M – Pasaraya, PT Central Lucky (Wholesale importer and retailer), Hero Supermarket, Hypermarket, Matahari.
- Makassar; Hypermart Makassar, Diamond Makassar.
- Bali; PT Bahana Gourmet, Lotus Distribution, Big Tree Farms, Bali Deli.

Observations from interviews

Supermarkets and their customers in Jakarta and Bali are familiar with imported product and would expect similar values in keprok supplies. The details required for these supermarkets to take on new product lines include:

- Price
- Shelf-life
- Flavour/taste
- Texture (soft or firm)
- Production capacity
- Transportation
- Packaging
- Weight
- Size (consistency)
- Colour inside and outside
- Farm system (visit for reassurance)
- Chemicals used
- Usage
- Any health benefits
- Volume
- Use-by date
- Peak season, including a description of product characteristics across the season.

Ideally, supermarkets would like a local contact person to deal with rejects and other quality issues as they arise. If direct supply is the preferred option, trading terms of 40 days after receipt is normal. Often trading terms are set early (Jan to March), so product submissions are required well before harvest (crop forecasting required). Typically, 1.5 tonnes is a minimum order from a supplier, and new product also needs to demonstrate a consistency of size.

Field demonstration plots, fruit storage and wax shipment trials

Demonstration plots were established in 2008, treatments applied and fruit quality data collected in 2009 & 2010. Detailed results can be found in West Timor region report in the appendices. Preliminary analysis of the data indicated that increased inputs (e.g., irrigation, mulch and fertiliser) greatly increased yield (2-3x) without loss of size, juice content and taste (brix:acid). Demonstration plots established in South Sulawesi indicated similar improvements with increased inputs. The trials in south Sulawesi also introduced pruning and thinning techniques that improved the average size and weight of fruit.

The appearance of the fruit under increased inputs was excellent and a trial shipment of waxed keprok SoE was organised in 2009. The results of the Kupang supermarket and Surabaya supermarket trials can be found in reports in the appendices. Briefly, the fruit sold out in Kupang well before differences in the condition between waxed and unwaxed product would be apparent. Although there was concern regarding the wax from some of the respondents of the survey the wax fruit sold out before the waxed fruit (both at same price). The keprok sent to Surabaya via vessel was over a week old before analysis and quality differences were obvious. The refrigerated fruit lost the least weight indicating the importance of cool storage in maintaining freshness. Interestingly, rind damage was much lower on waxed fruit regardless of storage temperature. The highest category of marketable fruit was the refrigerated and waxed fruit. This trend was confirmed in organoleptic testing by supermarket staff where the refrigerated fruit had the best taste and the waxed fruit the best appearance. The non waxed and non refrigerated fruit was clearly the least acceptable category.

Sorting and waxing keprok SoE at trader's house for trial shipment to local supermarket and inter-island trade.

Current market challenges for keprok SoE

Keprok SoE has a high cost of production relative to other citrus, which competes on quality and price in the retail sector. These costs will only be increased with any additional product inputs, packaging and branding. Presently supply is in limited volumes, and size

and quality is inconsistent. With no cold chain, product arrives in poor condition (relative to imported product) and doesn't have a long shelf life. Distance to market and transport system only makes this worse. Sorting and sizing is handled by the trader and upwards in the chain, who buys and sells on size only. The trader provides little if no information back to the grower, yet knows a great deal in terms of inter-regional conditions, seasonality and market pricing. Interestingly, retailers (supermarkets and hypermarkets) buy on detailed product descriptions and specifications that include colour, flavour, price, shelf life, volume, size, etc, but the grower is unaware of this. Quality for citrus appears to be driven from the retail-end of the chain with most of the quality control effort occurring from the retailer back to the trader. As a regional product, Keprok SoE is highly regarded, but has little awareness amongst the retail sector or consumers in Bali & Java, with those that have tried it sceptical of colour, level of sweetness, texture, and consistency of product. It also lands in the marketplace at the peak time for citrus, competing with many other popular imported and local varieties. Imported product is viewed by retailers and consumers as prestigious, and is considered a better quality product that is sweeter and cheaper. Imported product also enjoys a cold chain process which ensures a consistently better presented product over a longer shelf life period. Imported product presently accounts for 90% of sales in major hypermarkets across Indonesia.

Keprok as a commodity

To compete successfully as a commodity product in the current domestic retail sector, the keprok will have to be able:

To compete on price foremost

To supply consistent quality, size and colour, to retail specifications

To gain consumer appeal (particularly up against imported product)

Keprok as a niche product

- Limited high-end and niche retail opportunity exists for fresh citrus, but requires:
- Good colour (orange) throughout the supply season
- A guarantee of volume, quality and product consistency

Keprok as a processed product

A longer-term strategy, which might provide a competitive edge for the keprok, would be to create a new supply chain that adds value at the farmgate, thereby providing immediate returns to farmers, and marketing into a niche retail opportunity as:

- Marmalade/conserve
- Dried or glace product range
- Juice based product

Keprok SoE has significant impediments compared to imported citrus in product consistency, quality control issues, post harvest handling, logistics and supply volumes

Keprok Soe has the potential to be differentiated as either bicoloured or fully coloured however there is significant development required at all levels of the supply chain before market opportunities can be pursued

There is a lack of impetus for change as Keprok Soe achieves a relatively high price due to low volumes

There is an opportunity to look at contract growing for local citrus?

The scoping study report suggested that the 'ole ole' (gift) market at airports, particularly Kupang, is an opportunity worth exploring for the Keprok SoE. This is a small, niche opportunity, but could still provide a decent outcome for growers and the project.

Hotels like the “Sheraton”, seeking unique fruits, might be interested in a seasonal, high quality Keprok SoE.

While the Keprok Soe has potential to be differentiated on its ability to be either bicoloured or fully coloured unlike other domestic citrus, and also on its sweet/sour flavour profile, there is significant development required at all levels of the supply chain before market opportunities can be pursued. The major broad hurdles preventing immediate market development are a lack of volume until additional trees start baring fruit; inconsistency in product quality; the unreliable and variable transport options available; the need for a person or group to co-ordinate the supply chain; and some market perceptions on its quality, taste and consistency of supply in the market place beyond Kupang and Bali, namely Surabaya and Jakarta.

Even more significant than these issues is a lack of impetus for change. Currently the Keprok Soe achieves a relatively high price, certainly at the start of the season. Growers are in a position where they have trees, more often than not provided by the government free of charge, that are low on the list of priorities in comparison to their other crops. It is easy to understand why when the current preferred model of trading involves the farmer selling his entire crop while it is still growing on the trees, handing over responsibility for the crop’s growth, harvest, transport, grading and sale to a trader. All risk is eliminated and the farmer can concentrate on other crops. The trader too has little impetus for change when he can already source the required size and quality of fruit from a range of suppliers to fulfil requirements of current retailers and wholesalers.

Current market challenges for keprok from Sulawesi

The challenges for keprok growers in Sulawesi are similar to those for keprok SoE. Keprok farmers in South Sulawesi are replanting after disease has decimated earlier plantings. They are attempting to rebuild an established large market in Makassar. As in West Timor, the current preferred model of trading involves the farmer selling his entire crop while it is still growing on the trees, handing over responsibility for the crop’s growth, harvest, transport, grading and sale to a trader. The strategy is sensible while production is relatively low and demand exceeds supply. All risk is eliminated and the farmer can concentrate on his more lucrative crops like kapok and corn.

However, the situation is different for keprok (Siompu variety) grown in the Buton regency; an island 4 hours by boat from Kendari (the capital of South East Sulawesi). The citrus project had a demonstration site in the Wabula district, which currently has low production (2,297 trees; 5 tonnes fruit per annum in 2007) but there have been significantly plantings in this district with almost 300,000 new jeruk siompu trees planted on the island in 2007 - 2008. The supply of Keprok currently satisfies the local market in Bau Bau city, but there will be chronic oversupply when the newer planting come into production. There will be a strong imperative to develop inter-island trade to offload the increased production. This will be particularly challenging given the lack of cool storage infrastructure in Bau Bau.

Key distribution & marketing issues were:

- The market requires and pays for large fruit

  The largest size fruit makes the most money. This is a key issue for growers to address as it has an immediate impact on their income. Irrigation, pruning and fertilizer applications are some of the factors that can impact on fruit size.

- Cheap non refrigerated transport is available

  Non refrigerated transport options at reasonable prices exist for local citrus. However, this does impact on the shelf life of citrus, increases wastage and reduces returns to farmers.

- Cool chain is non existent for local fruits

  The availability of refrigerated containers in Makassar offers an opportunity to use a cool chain system for local fresh fruits. However, there are no cool storage facilities in the districts where the citrus is grown and farmers and traders do not see the benefit of using refrigerated transport for local fruits, despite wastage of up to 30% at some wet retail markets and 15% in transport. There is a busy port in Bau Bau, Buton Island, but the cool storage infrastructure does not exist. The roads from production areas in the east of the island are very poor and hamper the transporting of fruit to Bau Bau.

7 Impacts

7.1 Scientific impacts – now and in 5 years

This project has increased knowledge of the supply chains for marketing citrus locally in Eastern Indonesia, and for inter-island trade.

Field studies in West Timor provided supporting evidence that increase inputs increase fruit yield without sacrificing quality. Further work in South Sulawesi indicated that pruning and thinning increase size and weight of fruit without overall yield reduction. The Indonesian team members in West Timor and Sulawesi adapted crop estimation techniques to suit the different tree structure in those regions. This knowledge is the basis for determining regional crop estimation for orderly marketing and sales

The potential to prolong the shelf life of keprok SoE by waxing and refrigeration was demonstrated by the trial shipment for Kupang. The waxing method was successfully adapted to ensure good shelf life of the thin, delicate rind of keprok SoE.

The project verified that regional keprok can be grown and distributed inter-island to meet 'imported' fruit specifications. The supply chain indicated likely time-frames for inter-island trade using existing shipping route. This model can used as the basis for future trials.

7.2 Capacity impacts – now and in 5 years

Capacity building has occurred at a number of levels, from the growers through to a Kupang based trader and BPTP staff. There have been clear demonstrations of the importance of considering other supply chain participants and there is now a better understanding that a successful supply chain will be one that is driven by consumer demand.

Some activities to improve awareness of quality parameters include:

- The training in crop estimates and fruit sizing of citrus. Including visits to growers, packing sheds, marketing boards, wholesale markets and retail sector in South Australia.
- The training in methods for testing sugar and acid content in fruit, and maturity indexing of citrus.
- The training in the design of demonstration trials. These measurements are taken to assess fruit quality and are incorporated into production trials (eg, comparing 'traditional' with 'best practice' farming).
- The in-market assessment of competitor products and market specifications in relation to product quality, conducted in conjunction with BPTP staff.
- Trial shipment of waxed fruit and inter-island shipping to retailers. The collector was instructed in the methods of waxing fruit and the local retailer in Kupang cooperated in sales marketing surveys. We also negotiated refrigerated shipping through a local shipping agent (Meratus). The BPTP staff were involved in all aspects of this trial and produced a report on out-turn of fruit in Surabaya retail stores (see appendices).
- BPTP staff undertook training in Australia on citrus marketing, mandarin pruning and methods to control decay in storage.

Capacity building for extension officers and farmers will be through demonstrations and farmer school programs. BPTP staff in each region conducted demonstrations in techniques acquired during training in Australia.

7.3 Community impacts – now and in 5 years

The keprok tends to be the cash crop for growers with a diverse range of products grown through the year. The keprok is a low input cost product with a short season that demands relatively good prices in the marketplace. While consistency, production and marketing issues hold back the product's development it is often the major source of grower's annual income. Any improvements made in returns for this fruit make a significant difference to the grower. Anecdotal evidence suggests that cash income is often used to educate the next generation.

The supply chain approach to the project should strengthen the relationships between growers and the collector/trader. By improving the production methods and harvest techniques of the growers and giving the trader skills and the ability to deliver a better product to his customers, both the trader and the growers benefit from the potential of increased returns, elevated levels of control in the supply chain and improved, long-term loyalty to each other.

7.3.1 Economic impacts

Economic impact was not measured during this project. Income to the grower (and other sectors of the supply chain) may be improved over the next few years by implementing the 'best production' methods and improved marketing of citrus.

This is supported by our studies which showed that the supply chain for keprok is relatively uncoordinated and often includes improper post harvest handling procedures. Observations suggest that keprok dries out very quickly leading to heavy discounting, and overall reduced returns to growers. The trial waxing keprok SoE demonstrated a more coordinated approach and highlighted possible pathways for inter-island trade. The waxing and refrigeration resulted in improved appearance, shelf life and quality. Consistent improvement in post harvest handling, such as fruit waxing and refrigeration, will lead to reduced wastage, and subsequently, a proportional increase in grower returns.

However, the impetus for change may not occur until recent plantings bear fruit, increasing production sharply and leading to a need to new markets. Initially, growing higher quality fruit for the ole-ole market is likely to produce the greatest benefits for growers.

7.3.2 Social impacts

Social impacts were not measured during this project. Citrus is a minor crop in this region's mixed farming activities, but an important component in generating profitable income. The approach in this project has been based on changing behaviours rather than incurring greater capital costs to growers. For instance, sanitation and hygiene involved behaviour change and the use of common, inexpensive chemicals, such as bleach (chlorine) and sodium bicarbonate (baking soda).

Although the focus is on improving the income of grower communities, we believe that the regional trader is the key link in the supply chain. For this reason, we targeted a trader and the local supermarket in Kupang for the trial keprok shipment. We hoped to alter the way these two supply chain participants interact on a business level, which may have implications socially in small communities where these parties know each other well.

7.3.3 Environmental impacts

There are no anticipated changes to the environmental status of Keprok production in Eastern Indonesia. Current post harvest handling of citrus is basic and we attempted by by-pass high chemical use options. The types of chemicals promoted for sanitation in this project were classed as 'food-grade' or 'generally regarded as safe'. For instance, it was not the intention of this project to introduce synthetic fungicides for the control of post harvest diseases.

7.4 Communication and dissemination activities

Training

Training activities were a major component of the 2nd and 3rd objectives of this project. All team members attend the activities in West Timor, and they were periodically reviewed. Five team members from the different regions also spent time training in Australia.

Training activities by region during 2009 included:

West Timor

Activities:

- Learning current practices regarding decision points to harvest, harvesting, sorting and handling techniques;
- Introducing gentle harvesting techniques and clipping of fruit,
- Introducing methods to estimate fruit sizing and tree crop load.
- Introduce concept of maturity index (brix:acid testing)
- NTT staff design and establish demonstration plots (eg. different mulch/fertiliser plots), and manage subsequent season. We assist and provide methods to evaluate 'market quality' in the demonstration plots – establish 'before' values for demonstration plots in first season.

Grower harvesting keprok Soe using picking bag introduced from Australia

Australia

Activities:

Riverland citrus region

- Indonesian staff placed in the with crop monitors to learn ‘hands-on’ the techniques for crop forecasting and sizing,
- Visit to private insectary and crop monitor service to discuss damage thresholds and beneficial insects,
- Visit to conventional and organic citrus growers properties.

South Australian Research & Development Institute (SARDI), Adelaide:

- Introduce maturity testing using brix:acid ratios.
- Introduce concept of temperature management (cooling).
- Introduce weight loss measurements as indicators quality loss (compare waxed vs unwaxed fruit; compare cool storage vs ambient).
- Introduce fruit waxing.

The approach adopted by this project is for all potential partners of the supply chain to have direct access to the information and strategies developed. For harvesting and post harvest handling outcomes, we have worked with provincial agencies to disseminate information to the growers and local traders/collectors. The extension agencies have been involved to ensure ownership and relevance of the activities. All team members been involved in the work activities in NTT and are extending this knowledge to their respective regions.

Dr. Anto Hardiyanto, ICSFI, has coordinated dissemination materials (eg, posters, leaflets and brochures) and where possible has also develop “agro klinik" in each location for consultation, demonstration, and to facilitate the farmers needs.

Training activities by region during 2010 included:

West Timor region

Activities:

- Establishment and maintenance of demonstration plots (eg. different mulch/fertiliser plots).
- Wax trial in Kupang allowed training in the waxing of fruit and the design of fruit storage experiments, including ‘in store’ quality assessment.

Australia

Activities

- Indonesian staff travelled to the Riverland and Sunraysia citrus regions to visit citrus research stations, citrus plant nurseries and commercial citrus packingsheds.
- Visits to wholesale produce markets, orange processing plant and supermarket distribution centre and meeting with citrus marketing board executive to discussing marketing of citrus in Adelaide.
- Citrus storage trials pre-established at South Australian Research & Development Institute (SARDI), Adelaide, and used as ‘hand-on’ training of postharvest methods for staff.
- Indonesian staff instructed in methods to evaluate decay control chemicals and general hygiene.

- Trials conducted using a range of inexpensive and common food grade preservatives under different conditions.

Meetings, Field days and related activities

In 2008, a project planning meeting was held in April in Batu, Java. This was followed a site visit and village meeting at Ajaobaki, West Timor.

In 2009, a grower meeting and demonstration of fruit sizing and pruning techniques was held for kepro SoE in April at Ajaobaki, West Timor. This was followed by a grower meeting at Wabula, Buton island. A project workshop was held at BPTP offices in Makassar, Sulawesi. Dr. Peter Taverner outlined the activities required to coordinate the wax shipments from Kupang to Surabaya (see appendices). Mr. Craig Swanburry described the role of Fruit Doctors in servicing the Australian citrus industry and techniques to accurately measure fruit size and crop density. Finally, Mr. Andrew Green outlined the marketing system for Australian citrus and the role of crop estimates in orderly marketing.

In 2010, grower meetings to discuss quality management of keprok were undertaken in Jeneponto and Bantaeng, south of Makassar. A village meeting and demonstration of pruning techniques was held for in June at Wabula, Buton island.

Village meeting to discuss grower issues and marketing practices, Wabula, Buton Island

8 Conclusions and recommendations

KEY MARKETING ISSUES IMPACTING ON THE CITRUS SUPPLY CHAINS IN EASTERN INDONESIA

Weak grower engagement with the markets results in minimal feedback and lack of incentive for change

Most citrus growers sell their fruit direct to a collector (middleman) at whatever price is being offered by the buyer. The market does pay higher prices for large size fruit and citrus growers can increase their returns by adopting farming practices that increase fruit size.

Sorting and packaging of fruit can increase grower returns

Most collectors will buy from citrus growers the entire citrus crop at a single price. In general, any sorting of the fruit into size categories will occur at the pasar by the seller. Some traders who buy direct from citrus growers do pay different prices depending on fruit size as the market does pay higher prices for larger size fruit. Thus if growers sort and pack their citrus on the farm by size (S,M,L) then they are likely to receive a higher return.

Cool chain is non existent for local fruits

While the three provinces of South Sulawesi, SE Sulawesi and West Timor have harbour/port facilities for shipment of goods only the Makassar port has refrigerated containers as an integral part of their trading activities. Some other ports may use refrigerated containers for frozen fish. In some instances, imported fruits are shipped in refrigerated containers but all local fruits are shipped (exported and imported) in non refrigerated boxes / packages. In addition, there are no cool storage facilities in the citrus growing districts of the provinces and traders do not see the benefit of using refrigerated transport for local fruits, despite high wastage, when there are many cheap non refrigerated transport options available.

Segmentation of market outlets offers opportunities

There are many outlets which use / sell citrus and this presents an opportunity for citrus growers to segment the market and present different product mixes to different outlets. Most of the citrus is sold through the local pasars but there are good opportunities through the gift (ole-oleh) market at gift shops / airports, modern retailers and five star hotels.

- Oleh – oleh: develop gift baskets / packs (less than 2 kg) to sell at the main local airport for air passengers to buy for their friends or colleagues. This also helps to promote the region's unique range of produce.
- Modern retailers: There are now many more modern retailers operating in regional Indonesia and they are interested in promoting local fresh produce.
- Five star hotels: In regions like Bali there are specific import distributors that focus on supplying the five star hotels. As the citrus volumes increase this segment offers an opportunity for unique regional citrus varieties like keprok Soe.

9 References

9.1 References cited in report

Mr. Phillip Morey, The citrus market in Indonesia – an Eastern Indonesian perspective, ACIAR Project ID SMAR/2007/209

Dr Sherri Wei, Improved marketing of mandarins in East Nusa Tenggara in Indonesia and northern Queensland, ACIAR Project ID ASEM/1999/013

9.2 List of publications produced by project

Dr. Anto Hardiyanto, ICSFI, has coordinated dissemination materials (eg, posters, leaflets and brochures) and where possible has also develop “agro klinik" in each location for consultation, demonstration, and to facilitate the farmers needs.

The list of grower leaflets includes:

- Pemangkasan (Pruning)
- Penjarangan buah (Fruit Thinning)
- Pemupukan (Fertilizer)
- Pengendalian Diplodia (Diplodia control)
- Cara mengukur muatan buah per pohon yang ideal (Crop Forcasting)
- Pelilinan (Waxing)
- Cara menguningkan kulit buah (Degreening)
- Sanitasi Buah (Sanitation of fruit)

The project team members have also produced:

- Surabaya Survey Report by Kuntoro Boga Andri
- Greasy Spot by Craig Swanberry (Fruit Doctors)
- Citrus tree pruning notes by Craig Swanberry (Fruit Doctors)
- Supply chain & market assessment (Draft) by Elizabeth Gunner and Karen Shepperd.

See appendices for copies of these documents.

10 Appendixes

10.1 Appendix 1 – Demonstration plot report in East Nusa Tenggara

10.2 Appendix 2 – Demonstration plot report (Jeruk Siompu)

10.3 Appendix 3 – Demonstration plot report South Sulawesi

10.4 Appendix 4 – Greasy spot note

10.5 Appendix 5 – Citrus pruning note

10.6 Appendix 6 – Citrus study

Australia Indonesia Partnership

Kemitraan Australia Indonesia

PROGRESS REPORT

Demonstration Plot Report In East Nusa Tenggara

Region:

1. Osias Kefi's trees in Ajaobaki Village, Mollo Utara Sub District, Timor Tengah Selatan Regency
2. Sinar Tunbes A, Sinar Tunbes B, Sinar Oesena and Sinar Ajaupukan farmers groups in Ajaobaki Village, Mollo Utara Sub District, Timor Tengah Selatan Regency
3. Inpres Market in Kupang city
4. Ramayana Mall in Kupang city
5. Hokky, Giant Maspion and CITO hypermart markets in Surabaya
6. East Nusa Tenggara AIAT Soil Laboratory in Naibonat – Kupang

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2010

ABSTRACT

Soe mandarin citrus had big markets demand because one of the best citrus quality in Indonesia. The problems were low productions and productivity, minor crop on mix farming system, low inputs for production process, some diseases, and low farmers resources. Growers need learning how to manage their citrus. So ACIAR and IARD were done demonstration plot to show good practices compared traditional practices. The demonstrations aims to (a) to help of market driven developed of supply chain, (b) to help farmers to improve citrus farming for market oriented, and (c) to discover the best performance and making of longer storage of citrus fruit. The demonstrations was done in Ajaobaki village, and citrus some retailers in Kupang and Surabaya on late 2008 to 2010. The demonstrations compared good and traditional practices. The result showed: (a) citrus performance of good practices was healthier and more productive than traditional practices, mainly amount of fruit, (b) citrus marketing was no problem and dominated by compiler merchant, (c) Assessment in Kupang Ramayana Mall showed wax citrus faster sold than non wax citrus each others four days and six days, (d) for interisland sold, refrigerated fruit better than non refrigerated because weight decreased 1.41-3.33% on refrigerated and 5.94-23.08% on non refrigerated, (e) although wax treatment better than non wax, organoleptic assessment of citrus fruit quality in Hokky Fruit Store, Giant Maspion and CITO hypermart markets in Surabaya showed refrigerated treatment better than non refrigerated because had high rating of taste, juice, texture and appearance on all fruit super markets, and (f) regression analysis showed relation forecasting used forecasting square equipment and actual amount of fruit gradually increased with cubic equation $y = 0.03x^3 - 2.163x^2 + 54.37x - 222.0$.

Key words: ***Soe Mandarin Citrus, Demonstrations Plot, Fruit Quality***

INTRODUCTION

Background

Indonesia is the forth greatest potential market in the world with population 220 million on 2005. If population growth is 1.76% per year, Indonesian populations increase about twice on the middle of 21th century and four times on the end this century. The big of populations and increasing of health awareness caused increasing of quantity and quality food requirement. It's opening modern retail sector to develop commerce fresh food in Indonesia.

Indonesia traditional market dominate commerce fresh food now, but modern market with good service and owning fruit import such as supermarkets and hypermarkets are developed. Modern retails were located in Java Island and a little on eastern Indonesia mainly on South Sulawesi.

Citrus fruit are important commerce commodities on modern retail market. On modern market, retailers have access of local and import citrus fruit to selling so they can sell citrus fruit on long time. Commonly, modern retail sold the best citrus fruit with higher price. Citrus fruit import were increase more than 20% per annum, while local Indonesia only 3.6%. 22% of citrus fruit imports were 53,659 ton of mandarin (keprok) citrus fruit and 29,712 ton of Valencia (manis) citrus fruit on 2005. China is the biggest supplier of mandarin and Valencia citrus that are 72% and 38%.

Over the last six years, citrus production in Indonesia has increased by about 400% to reach 2.2 million tons in 2005, from about 70,000 hectares. During this period the productivity increased from 19 tons to 33 tons per hectare. While most of Indonesia's 33 provinces grow citrus, five provinces dominate production as follows: North Sumatra (586,578 tons), East Java (395,428 tons), South Sumatra (218,397 tons), South Sulawesi (157,783 tons) and West Kalimantan (146,314 tons); these provinces account for 70% of Indonesia's production. East Indonesian citrus accounted for 11.9% of the volume of all citrus produced in Indonesia in 2005. Over the last six years, production of citrus in East Indonesia has increased by only 163% compared to 392% across all provinces.

NTT is only a minor citrus producing province in Indonesia with 21,434 tons in 2005 from 956 hectares, up from 17,105 tons in 1999; only a 25% increase. NTT's share of citrus production in Indonesia has decreased from 3.8% to 1.0% over the last 6 years. During this period, citrus yield has increased from 16.9 tons to 22.4 tons per hectare.

Citrus is grown in most of the regencies with 11 regions having more than 1,000 tons of production. The main production regency is Timor Tengah Selatan and Timor Tengah Utara District with about 4,500 tons.

Market opportunities of Soe mandarin citrus in East Nusa Tenggara still open to developed. All of research that learning about consumers interest showed Soe mandarin citrus quality was better than other mandarin citrus of local Indonesia, mainly on color aspect. Although demand of Soe mandarin citrus is big, but the production was slimmest, so it can't fulfill market demand. It can see thought: (a) Soe mandarín citrus was found sales in local market only, and (b) high price on producers level there are Rp. 5.000 – 10.000 per kg. It caused price on consumer level up to Rp 8.000 – 12.000 per kg. This price is the same as citrus import price in Kupang city super market.

Some issues about production development and marketing of Soe mandarin citrus in East Nusa Tenggara are:

Production Issues

- Soe mandarin citrus production were increase, but still few and low productivities
- Citrus was minor crop on mix farming system
- Low inputs for production process
- Some diseases problems
- Need for disease free certified trees
- Short harvest season for citrus
- Low farmers resources

Distribution & Marketing Issues

- Weak farmer bargaining power
- The market requires and pays for large fruit
- Packaging is available but is rarely used
- Competitive & comparative advantages are except for Soe mandarin citrus from Kapan – Eban area

Aim

The objectives of this research were:

1. To help of market driven developed of supply chain.

2. To help farmers to improve citrus farming for market oriented
3. To discover the best performance and making of longer storage of citrus fruit

METHODOLOGIES

The main activities were conducted on Ajaobaki village, Mollo Utara district, Timor Tengah Selatan regency on 2008 - 2010. There were three activities that were demonstration plot of Soe mandarin citrus management, improving citrus quality for market oriented, and forecasting of Soe mandarin citrus.

1. Demonstration plot of Soe mandarin citrus management

a. Main demonstration

Demonstration was conducted on Osias Kefi's garden on 2009 and 2010 season. The main demonstration was objective to show effect of fertilizing, mulching, and watering to citrus productivity. The demonstration showed two groups there were citrus with good practices such as fertilizing, mulching and watering compared with traditional practices as control. Amount of each group was 6 trees, so total trees were 12 trees. Determination of tree was in a couple based on tree performance (age and branch), so this demonstration used 6 couples that were tree number 1 couple with number 2, tree number 3 couple with number 4, etc. All of trees were attached a label.

Technology component were used to show as follows:

- Fertilizing was twice that were before rainy season with phonska fertilizer 1.3 kg/tree (N 15%, P2O5 15%, K2O 15%, Sulfur 10%) + 20 kg of manure and after rainy season with phonska fertilizer only 1.3 kg/tree.
- Watering used bamboo drop irrigation at early flowering phase.
- Other technologies management were similar such as Diplodia disease control with California mush twice per year at before and after rainy season.

Data collect were flowering cluster, amount of fruit, fruit diameter, color of fruit, weight of fruit, weight of juice, acid rate, and sugar rate (brix).

Flowering cluster was observed by marking branch at fourth side of tree. Amount of flower on each side were counted, and then amount of fruit were counted after mature. Percentage of fertile fruit was counted by ratio of fruit and flower with formula as follow:

$$\% \text{ fertile fruit} = \frac{\text{amount of fruit}}{\text{amount of flower}} x100\%$$

Amount of fruit was counted all of citrus fruit per tree on harvest time. Fruit diameter was conducted when 50% fruit physiological matured that was showed 50% turning yellow. Measurement of fruit diameter was conducted by taking 50 fruits per tree in random.

Measurement of fruit color was conducted on 20 fruits in random. Measurement use color fruit chart as follow:

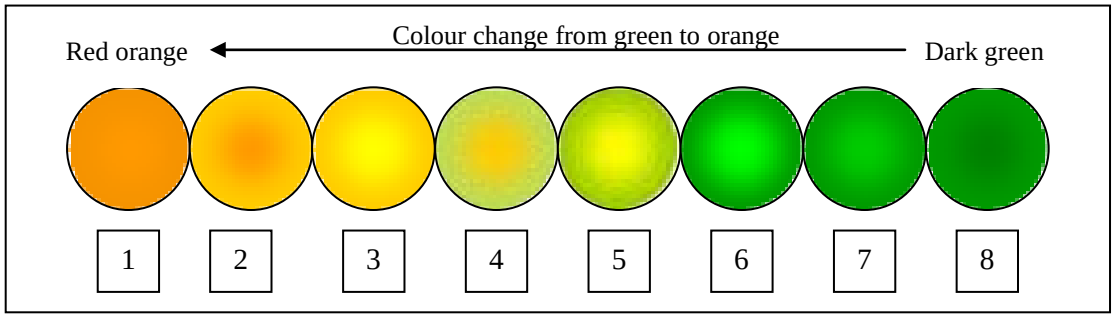


Figure 1. Color fruit chart

Measurement of weight fruit, juice content, acid rate and sugar rate were conducted on 12 fruits in random on the same fruits. Measurement of juice content was conducted after weight fruit observation. Juice content was water fruit with no husk, seed and other dregs.

The procedures to acid rate measurement as follow:

Equipment

200ml Erlenmeyer flask

50 ml Burette with stand

Phenolphthalein indicator solution

0.1 N Sodium Hydroxide (NaOH) solution

Method

(I) Transfer 10 ml fruit juice to a 200 ml Erlenmeyer flask

(II) Add 5 drops of phenolphthalein indicator.

(III) Titrate with a 0.1 N sodium hydroxide from a 50 ml burette. Use a white tile or white paper under the Erlenmeyer flask so as to see the endpoint more clearly. The contents of the Erlenmeyer should be constantly

mixed during the titration. An easy method is to operate the tap of the burette with the left hand and swirl the contents of the Erlenmeyer counter-clockwise with the right hand holding the neck of the Erlenmeyer. When the endpoint is approached the solution in the Erlenmeyer shows a streak of pink arising from the point where the sodium hydroxide enters the juice. This becomes progressively larger as more sodium hydroxide is added, but the pink color disappears rapidly after it has formed. Continue adding sodium hydroxide drop by drop. The end point of the titration is when the pink colour persists throughout the solution for 5 seconds after the last addition of sodium hydroxide from the burette.

(IV) Read the contents of the burette at the bottom of the meniscus.

(V) Calculate the percentage as follows:

$$\%acid = \frac{ml\ of\ NaOH\ titrated}{ml\ of\ fruit\ juice\ (=10)} x \frac{normality\ of\ NaOH\ used\ (=0.1)}{constant\ (=0.1562)}$$

$$\%\ acid = ml\ of\ NaOH\ titrated\ x\ 0.064$$

Notes:

- It is necessary to know what the strength (or normality) of the sodium hydroxide solution to calculate the constant value. The normality of the NaOH used MUST be 0.1 N for the constant value to be equal to 0.1562 in the above equation.
- Sodium hydroxide solution weakens with storage unless its container is tightly closed because it reacts with the carbon dioxide in the air.
- Typical % acid value for oranges range from 0.5 to 1.5%.

Measurement of sugar content used refractometer. The procedure of refractometer was done by drip one drop of orange juice on refractometer measurement glass scale and number in refractometer scale showed sugar content (brix).

b. Secondary Demonstration Plot

Secondary demonstration plot was objective to show to farmers group that good practices could be increase citrus productivity. The demonstration was done on four farmers groups as follows:

Table 1. Secondary demonstration plot of citrus on Ajaobaki Village

No	Name of farmers group	Head of farmers group	Ownership of citrus (trees)	Demonstration trees	
				Good practices	Traditional practices
1	Sinar Tunbes B	Emanuel Baun	108	54	50
2	Sinar Oesena	Osias Kefi	128	32	32
3	Sinar Tunbes A	Ruben Mnune	60	30	30
4	Sinar Ajaupukan	Esa Kono	70	41	35

Technologies introduction to show were fertilizing, mulching, watering, and Phytophthora and Diplodia control with California mush and then good practices would compared than traditional practices.

Technology component were used to show as follows:

- Fertilizing was twice that were before rainy season with phonska fertilizer 1.3 kg/tree (N 15%, P2O5 15%, K2O 15%, Sulfur 10%) + 20 kg of manure and after rainy season with phonska fertilizer only 1.3 kg/tree.
- Watering used bamboo drop irrigation at early flowering phase. Each farmers group was helped 4 (four) fiber and 10.000 liters of water.
- Other technologies management were similar such as Diplodia disease control with California mush twice per year at before and after rainy season.

Data collect was amount of fruit only

.

2. Influence of citrus fruit quality to long storage and respond of retailers at local markets in Kupang City and interisland retailers in Surabaya City

The research was objective to assessment citrus quality as long as storage before consumers hand. Data collect as follows:

- Acceleration of sale and consumers respond to wax and non wax citrus quality. This research was conducted trough presented 40 kg wax and 40 kg

non wax citrus at Kupang Ramayana Mall. This research was supported Mr. Fredy Lomer as citrus supplier to Kupang Ramayana Mall.

- Assessing citrus quality from producers in Soe to Surabaya retailers. The treatment was assessed 4 treatment combined as follows:
  - Wax citrus on refrigator
  - Non wax citrus on refrigator
  - Wax citrus on room;chamber temperature
  - Non wax citrus on room;chamber temperature

  To support this research were Kupang Ramayana Mall as cold storage owner, PT. Meratus as good delivery services from Kupang to Surabaya, Melita ship, and Hokky, Giant Maspion and CITO hypermart markets.

  Observation aspects were weight decreased and damage percentage as long as trip.

3. Forecasting amount of Soe mandarin citrus fruit with sizing ring

Forecasting was done on mature Soe mandarin citrus fruit on late August 2010. Measured used forecasting frame 0.5 m x 0.5 m x 0.5 m made from 10 mm square aluminium steel with 0.5 m prongs at each corner. The counting frame is four sites (north, west, south and east) placed in 0.5 – 1 m near the canopy with prongs pointing towards the trunk and outer edge of the frame at the canopy, at a height between 1.0-2.5 m from the ground.

RESULT

1. Demonstration plot

a. Main demonstration plot

Paired-sample T-test analysis of age, height, and canopy circle were not significant among good and traditional practices. Nevertheless, in general citrus performance of good practices was healthier and more productive than traditional practices. It showed leaves density and fruit density. Leaves density of good practices was gradually increased. Medium leaves density was lower (50% to 33.33%), while height leaves density was higher (33.33% to 50%). Good practices increased fruit density because less fruit density was lower than traditional practices (50% less than 66.7%), while height fruit density was higher (0% on traditional practices and 16.7% on good practices) (Table 2).

Table 2. Citrus performance comparison between good and traditional practices 2010

Observation	Good practices	Traditional practices	t-test
Age of citrus (years)	19.67	18.00	ns
Canopy diameter (cm)	296.58	280.17	ns
Height (cm)	425.59	423.67	ns
Canopy's circle (cm)			
- Root stock	57.4	60.0	ns
- Scion	58.8	61.2	ns
Fruit density (%)			
- Less	50.0	66.7	-
- Medium	33.3	33.3	-
- Dens	16.7	-	-
Leaves density (%)			
- Low	16.7	16.7	-
- Medium	33.3	50.0	-
- Height	50	33.3	-

Paired-samples T-test analysis significant on amount of fruit only among good and traditional practices, while other observation such as fruit diameter, weight fruit, fruit color, juice weight, acid and sugar content were not significant. Average amount of fruit on good practices was 274.42 higher than traditional practices 90.69. Observation component supported amount of fruit was fertile flower. Good practices fertile flower was 40.09% higher than traditional practices 15.20% only.

Increasing fertile flower possibility caused watering application on early flowering and fruit forming phase. Watering strengthening flower-twig bound so flowers could not easy to drop, as a result fertile flower on best practices increase.

Watering and other practices were very important on citrus cultivation. Although water irrigated was very limited in this village. In the future must be multiplied water trap for irrigation. Others, good practices had opportunities to developed in this area instead traditional practices because citrus cultivation by growers commonly were no fertilizing, no pruning, no thinning and no controlling to pest and disease and never use clip to harvest fruit, no waxing and store in normal temperature.

Table 3. Citrus productivities comparison between good and traditional practices

Observation	Good practices		Traditional practices		t-test
	2009	2010	2009	2010	
Amount of fruit	233.33	315.50	103.88	77.5	Sig. 0.043
Fruit diameter (cm)	6.28	6.51	6.31	6.19	ns
Weight per fruit (g)	110.16	118.74	97.74	108.38	ns
Fruit color	4.13	3.38	4.53	3.4	ns
Weight juice per fruit (g)	48.73	41.25	46.98	39.93	ns
Fertile flower (%)	40.09	-	15.20	-	
Acid content (%)	0.14	0.19	0.18	0.19	ns
Sugar content (brix)	9.04	8.96	8.74	8.77	ns

b. Secondary demonstration plot

Secondary plot showed average amount of fruit on good practices 232.68 fruits/tree and traditional practices was 63.58 fruits/tree. Independent-samples T-test compared amount of fruit among good and traditional practices was 0.0001 (Appendix). It showed amount of fruit on good practices greater than traditional practices.

2. Influence of citrus fruit quality to long storage and respond of retailers at local markets in Kupang City and interisland retailers in Surabaya City

a. Traditional market in Kupang

Marketing of mandarin Soe citrus in Kupang was dominated by compiler merchant. Compilers bought up all of fruit from growers. Growers seldom sold his fruit to the markets.

Commonly, supply chain of mandarin citrus follows:

Citrus grower ➔ compiler merchant ➔ retailers in Soe or retailers from Kupang

Mix citrus fruit (big-small) were orderly pack on 40 kg. One pack of citrus prices was Rp.400.000 – 600.000 (AUS$ 57 – 85).

Fruit sort was done by retailers and the classification:

Table 4. Grade and price in Kupang Inpres market

Grade	Diameters (cm)	Price per kg (Rp)	Market location
A	9	25.000	Inpres-market in Kupang
B	8-8,9	22.500	
C	7-7,9	20.000	
D	6-6,9	17.500	
E	5-5,9	15.000	
F	4-4,9	12.500	
G		10.000	

c. Supermarket in Kupang

Observation in Ramayana Mall in Kupang showed wax citrus faster sold than non wax citrus. Wax citrus were sold four days, while non wax five to six days. Ramayana sold Rp.33.525 (AUS$ 4.47) per kg.

d. Supermarket in Surabaya

Citrus fruit were storage on four combination treatment that was waxed, non waxed, refrigerated and non refrigerated. Treatment was done in Kupang Ramayana Mall and than was send to Surabaya retailers helped PT. Meratus as good delivery services from Kupang to Surabaya and Melita ship.

Main problem on fruit sending was uncertainty schedule of ship. Citrus fruits were expected as quickly as possible accepted by retailers to decreased damage percentage. It's planned less than 7 days had interisland retailers hand since harvesting, but long trips was 13-15 days.

Observation showed refrigerated better than non refrigerated because weight decreased and damage percentage slimmer. Waxing decreased damage percentage, but not significant with non wax (Table 5).

Table 5. Weight decreased and damage citrus of any combination treatment

Treatment	Weight decreased (%)	Damage (%)
Wax + refrigerated	1.41	2.67
Wax + non refrigerated	5.98	16.67
non wax + refrigerated	1.79	3.33
non wax + non refrigerated	5.94	23.08

Organoleptic assessment of citrus fruit quality in Hokky Fruit Store, Giant Maspion and CITO hypermart markets in Surabaya showed Table 6, 7, 8. Assessment showed refrigerated treatment better than non refrigerated because had high rating of taste, juice, texture and appearance on all fruit super markets.

Table 6. Organoleptic assessment on Hokky Fruit Store Surabaya

	Taste	Juices	texture	appearance
Waxed Refrigerated	+++	++++	+++	++++
Waxed Non Refrigerated	++	+++	++	++++
Non Waxed Refrigerated	+++	++++	++	++
Non Waxed Non Refrigerated	++	+	+	+

Table 7. Organoleptic assessment on Giant Maspion Surabaya

	Taste	Juices	texture	appearance
Waxed Refrigerated	++++	++++	++++	++++
Waxed Non Refrigerated	+++	++	+++	++++
Non Waxed Refrigerated	++++	+++	+++	++++
Non Waxed Non Refrigerated	+++	++	++	++

Table 8. Organoleptic assessment on CITO hypermart Surabaya

	Taste	Juices	texture	appearance
Waxed Refrigerated	++	++++	++++	+++
Waxed Non Refrigerated	++	+++	++	+++
Non Waxed Refrigerated	++	++++	+++	++
Non Waxed Non Refrigerated	+	++	+	+

3. Forecasting amount of Soe mandarin citrus fruit with sizing ring

Correlation analysis among actual and forecasting mount of fruit was significance 0.822. Its mean amount of fruit in forecasting increased along actual fruit. Regression analysis showed relation forecasting used forecasting square equipment and actual amount of fruit gradually increased with cubic equation $y = 0.03x^3 - 2.163x^2 + 54.37x - 222.0$. This regression was different with Valencia citrus in Australia, which Valencia citrus equation was linier regression. It's caused leaves density of Soe mandarin citrus lesser than Australia Valencia citrus, so transparent and double counting happened on each side observations (Appendix).

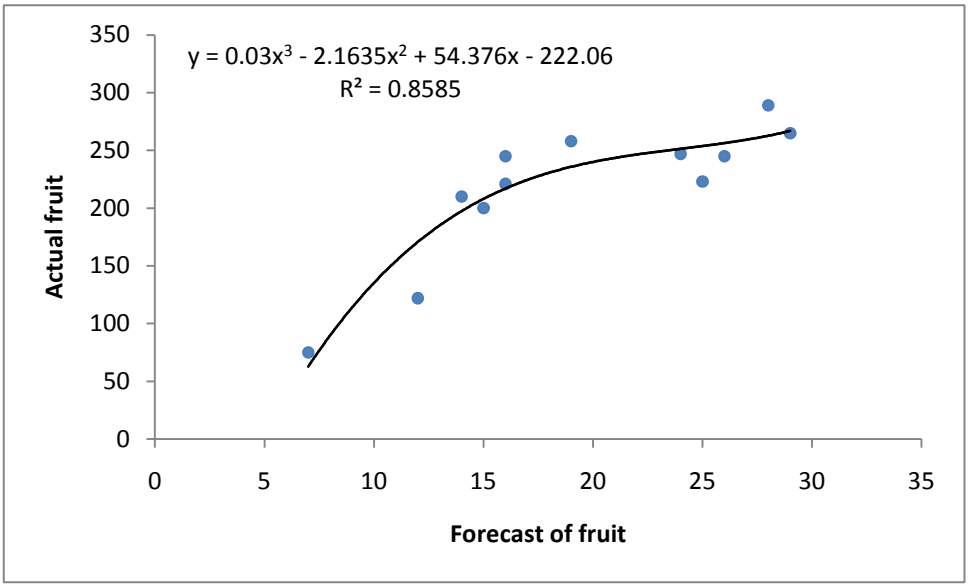


Figure 2. Regression analysis of forecast and actual amount of fruits

APPENDICES

1. Leaflets for the farmer

No.	Name of leaflets/folders
1.	Penjarangan buah jeruk keprok Soe (Thinning method of Soe Mandarin Citrus)
2.	Pemupukan jeruk keprok Soe (Fertilizing method of Soe mandarin citrus)
3.	Pengendalian penyakit blendok Diplodia (Controlling technique of Diplodia disease)

2. Paired samples T-test amount of fruits of main demonstration plot

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Amount of fruit-treatment	266.2000	10	218.15988	68.98821
	Amount of fruit-control	95.8000	10	102.91075	32.54324

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Amount of fruit-treatment & amount of fruit-control	10	.128	.724

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Amount of fruit-treatment - amount of fruit-control	170.40	228.98675	72.41197	6.59274	334.20726	2.353	9	.043

3. Independent samples T-test amount of fruit of secondary demonstration plot

Group Statistics

	Demonstration	N	Mean	Std. Deviation	Std. Error Mean
Amount of fruit	Treatment	150	232.6800	390.30068	31.86792
	Control	150	63.5733	110.07138	8.98729

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Amount of fruit	Equal variances assumed	33.423	.000	5.107	298	.000	169.10667	33.11096	103.94574	234.26759
	Equal variances not assumed			5.107	172.552	.000	169.10667	33.11096	103.75201	234.46132

4. Correlation and regression analysis of actual and forecasting amount of fruits

Correlations

		Forecast of fruit	Actual fruit
Forecast of fruit	Pearson Correlation	1	.822**
	Sig. (2-tailed)		.001
	N	12	12
Actual fruit	Pearson Correlation	.822**	1
	Sig. (2-tailed)	.001	
	N	12	12

**. Correlation is significant at the 0.01 level (2-tailed).

Cubic

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.927	.858	.805	27.003

The independent variable is Forecast of fruit.

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	35381.478	3	11793.826	16.175	.001
Residual	5833.188	8	729.149		
Total	41214.667	11			

The independent variable is Forecast of fruit.

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
Forecast of fruit	54.376	27.386	6.237	1.986	.082
Forecast of fruit ** 2	-2.164	1.667	-9.536	-1.298	.231
Forecast of fruit ** 3	.030	.031	4.154	.957	.367
(Constant)	-222.058	139.700		-1.590	.151

DEMONSTRATION PLOT REPORT (2010)

Region : Wa Asma Trees, Buton, Southeast Sulawesi

Summary

Jeruk Siompu is one of excellent citrus in Southeast Sulawesi. However, the quality of the citrus is very low, so the price that can be got by the farmer very low. Therefore, the enhancement of Jeruk Siompu quality including preharvest and postharvest is needed to be done. The aim of the research is to enhance the quality of Jeruk Siompu by improving the preharvest practices and introducing postharvest technologies. The result showed that the application of preharvest technologies such as fertilizing, thinning, pruning and irrigation improved significantly the bigger fruit size 64.81 mm as compared to control 61.00 mm, and 55.75 mm for treated trees as compared to control 51.75 mm at the fruit seasons 2009 and 2010 respectively. The result of postharvest practices at fruit season of 2009 showed that the degreening treatment improved significantly the soluble solid concentration and juice content, meanwhile the waxing treatment significantly inhibit the ripening process. The same result showed at the fruit season of 2010, in which the degreening treatment improved significantly the juice content but not for soluble solids concentration. Besides, at the fruit season of 2010, the waxing treatment inhibit the ripening process. Furthermore, the result also showed that the preharvest application improved significantly the size of jeruk Siompu, especially at the fifth up to seventh month after flowering.

REPORT

Aim

Melakukan aplikasi teknologi pra-panen (pemupukan, irigasi, penjarangan buah dan pemangkasan) dan pasca panen (sanitasi buah, degreening dan pelilinan) guna meningkatkan kualitas buah jeruk Siompu. (To increase the quality of Siompu citrus through application of pre-harvest technology

Methods

1. Kegiatan Pra-Panen.

Rancangan yang digunakan adalah Rancangan Acak Kelompok (RAK), terdiri dari 2 perlakuan; yaitu 1) Aplikasi Paket Teknologi Pra Panen (pemupukan, penjarangan buah, pemangkasan dan irigasi), dan 2) kontrol (tanpa perlakuan). Masing-masing perlakuan diulang 4 kali. Parameter yang diamati adalah ukuran buah dan perkembangan buah jadi. Data ditabulasi dan dianalisa secara statistik menggunakan Anova dan uji lanjut menggunakan Uji BNT.

2. Kegiatan Pasca Panen

Rancangan yang digunakan adalah Rancangan Acak Kelompok (RAK), terdiri dari 4 perlakuan, yaitu; 1) degreening, 2) pelilinan, 3) kombinasi degreening + pelilinan, dan 3) kontrol. Masing-masing perlakuan diulang 4 kali. Parameter yang diamati adalah kandungan jus, padatan total terlarut, asam tertitrasi dan uji organoleptic rasa. Masing-masing parameter diamati selama 21 hari

penyimpanan, yaitu; 0 hari, 7 hari, 14 hari dan 21 hari. Data ditabulasi dan dianalisa secara statistik menggunakan Anova dan uji lanjut menggunakan Uji Duncan.

Equipment Used

1. Gunting Pangkas
2. Pacul
3. Bambu Irigasi
4. Tangga Panen
5. Ember
6. Kantong Panen
7. Hand Spayer
8. Rafraktometer
9. Buret
10. Gelas ukur
11. Pisau
12. Timbangan
13. Perlengkapan uji organoleptik
14. Sikat
15. Alat tulis

How did you involve the farmers?

1. Melakukan pertemuan kelompok petani jeruk dan pedagang jeruk, khususnya saat kunjungan TIM Aciar Australia
2. Melakukan pertemuan dengan petani kooperator secara berkala yang disesuaikan dengan topik diskusi teknologi di areal pertanaman jeruk, sambil melakukan praktek lapangan.

Results

A. Preharvest

Treatments	Variables				
	Size	Acidity	Brix	Juice	Taste
Control	61.00[b]	1.43[a]	7.00[a]	31.77[a]	3.25[a]
Treated Trees	64.81[a]	1.55[a]	7.55[a]	29.71[a]	3.25[a]

Table. 1. Effects of the preharvest treatments (2009) on the size, acidity, brix, juice and taste of keprok Siompu after harvesting.

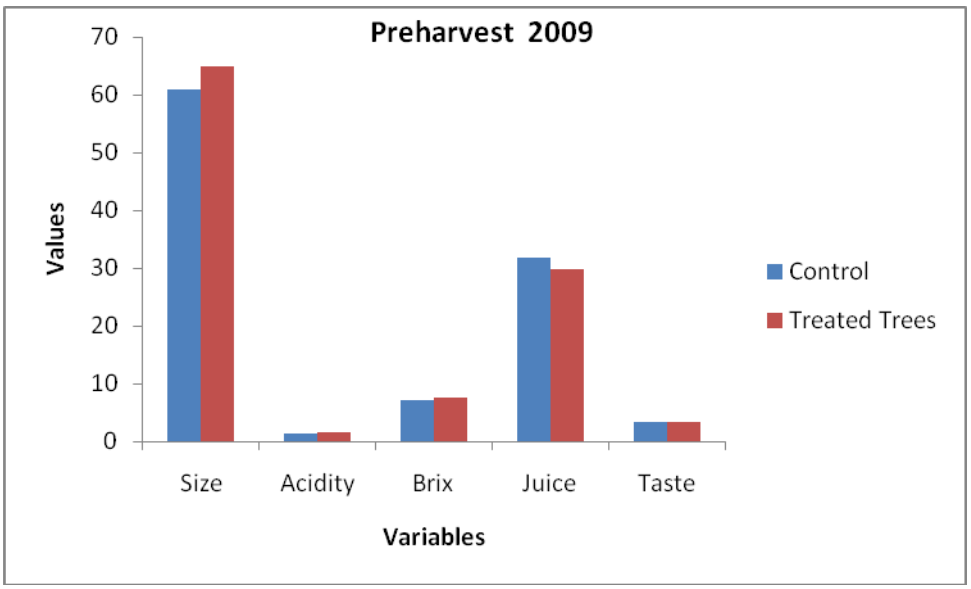


Figure 1. Effects of the preharvest treatments (2009) on the size, acidity, brix, juice and taste of keprok Siompu after harvesting

Treatments	Variables				
	Size	Acidity	Brix	Juice	Taste
Control	51.75[b]	1.26[a]	8.30[a]	47.53[a]	3.25[a]
Treated Trees	55.75[a]	1.45[a]	9.10[a]	46.52[a]	3.50[a]

Table 2. Effects of the preharvest treatments (2010) on the size, acidity, brix, juice and taste of keprok Siompu after harvesting

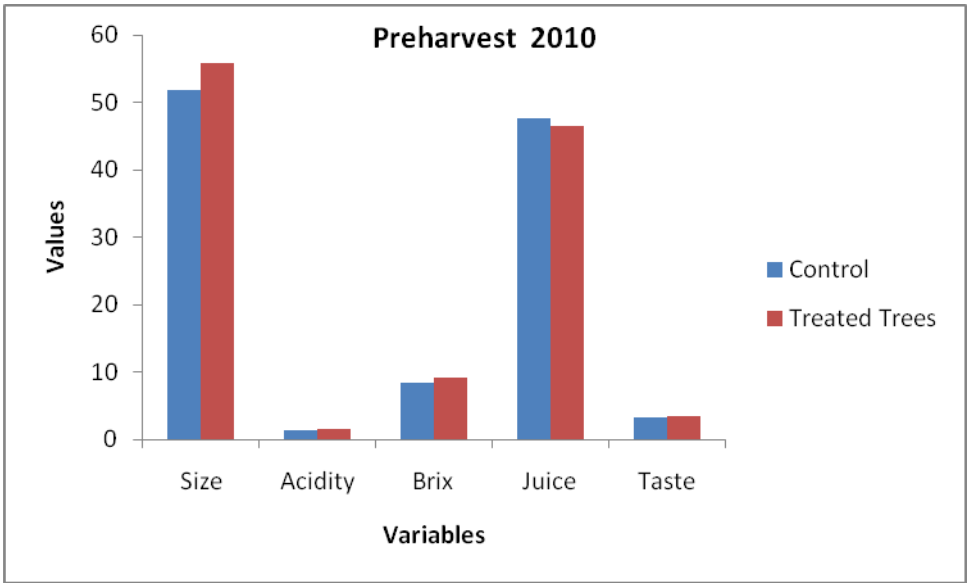


Figure 2. Effects of the preharvest treatments (2010) on the size, acidity, brix, juice and taste of keprok Siompu after harvesting

B. Postharvest

Table 3. Effects of the postharvest treatments (2009) on the acidity, brix, juice and taste of keprok Siompu after 0 day of storage.

Treatments	Variables			
	Acidity	Brix	Juice	Taste
Control	1.55[a]	9.10[a]	29.72[a]	3.25[a]
Degreening	1.86[a]	8.78[a]	37.19[a]	3.50[a]
Waxing	1.69[a]	8.78[a]	29.55[a]	3.25[a]
Deg + Wax	1.41[a]	8.65[a]	28.66[a]	3.50[a]

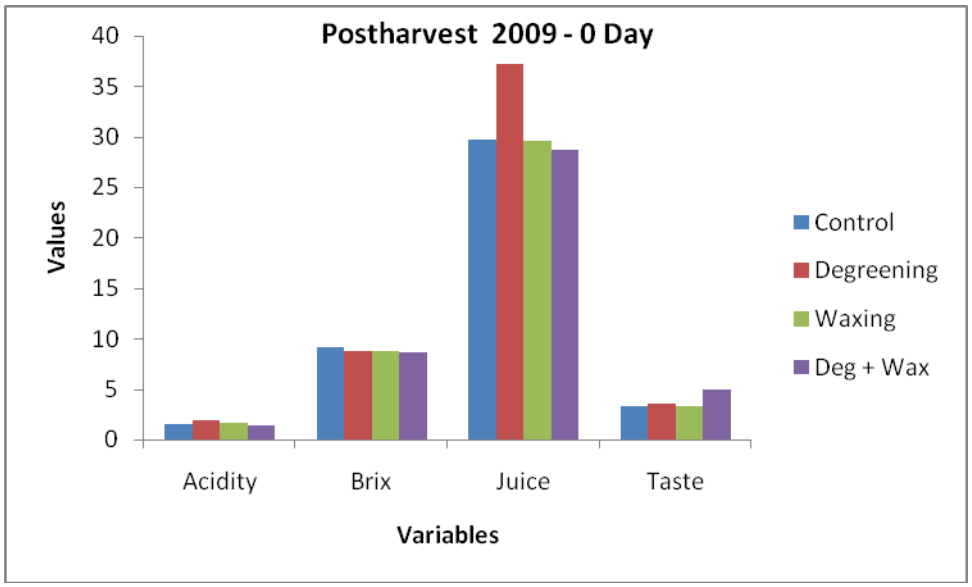


Figure 3. Effects of the postharvest treatments (2009) on the acidity, brix, juice and taste of keprok Siompu after 0 day of storage.

Table 4. Effects of the postharvest treatments (2009) on the acidity, brix, juice and taste of keprok Siompu after 7 days of storage.

Treatments	Variables			
	Acidity	Brix	Juice	Taste
Control	1.63[a]	8.80[a]	39.53[bc]	3.75[a]
Degreening	1.33[a]	9.05[a]	43.89[a]	4.75[a]
Waxing	1.42[a]	8.25[ab]	37.72[c]	4.25[a]
Deg + Wax	1.71[a]	7.90[b]	41.16[b]	4.25[a]

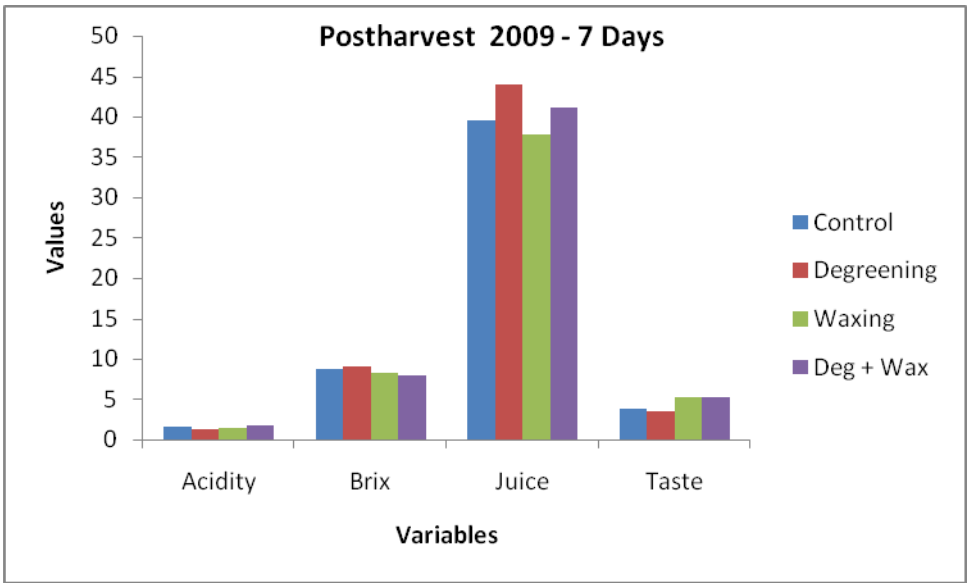


Figure 4. Effects of the postharvest treatments (2009) on the acidity, brix, juice and taste of keprok Siompu after 7 days of storage.

Table 5. Effects of the postharvest treatments (2009) on the acidity, brix, juice and taste of keprok Siompu after 14 days of storage.

Treatments	Variables			
	Acidity	Brix	Juice	Taste
Control	1.23[a]	9.30[ab]	38.39[ab]	3.00[a]
Degreening	1.21[a]	9.23[ab]	42.43[a]	3.25[a]
Waxing	1.50[a]	9.53[a]	35.49[b]	3.25[a]
Deg + Wax	1.40[a]	8.68[b]	38.63[ab]	3.25[a]

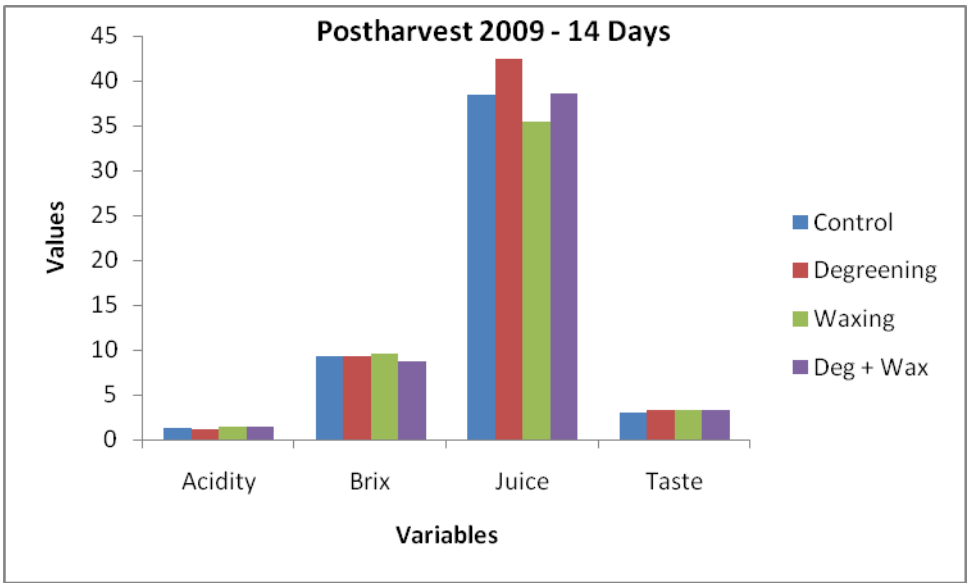


Figure 5. Effects of the postharvest treatments (2009) on the acidity, brix, juice and taste of keprok Siompu after 14 days of storage.

Table 6. Effects of the postharvest treatments (2009) on the acidity, brix, juice and taste of keprok Siompu after 21 days of storage.

Treatments	Variables			
	Acidity	Brix	Juice	Taste
Control	0.99[a]	9.35[a]	37.14[a]	4.25[a]
Degreening	1.09[a]	8.80[a]	43.51[a]	3.75[a]
Waxing	0.95[a]	9.40[a]	43.49[a]	3.75[a]
Deg + Wax	1.00[a]	8.80[a]	42.19[a]	3.75[a]

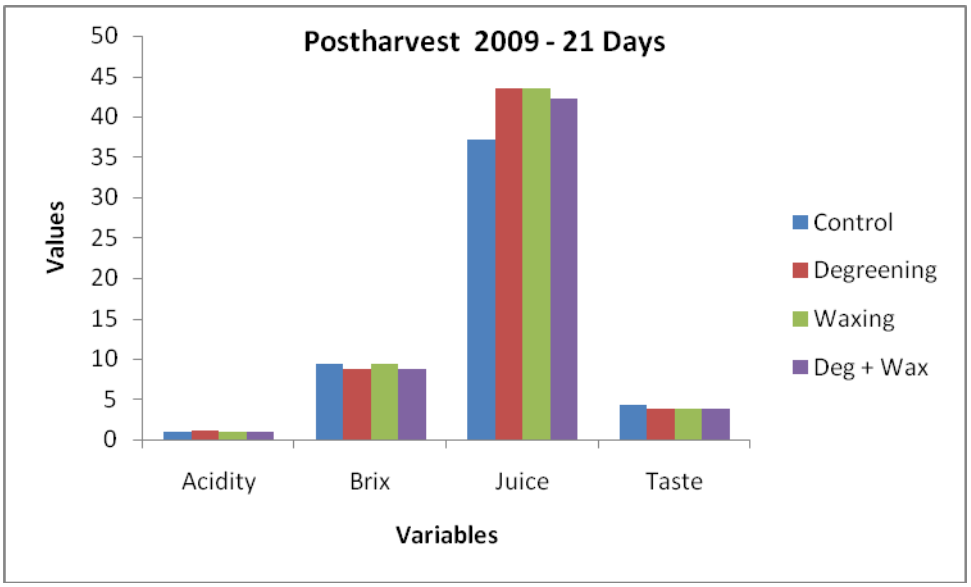


Figure 6. Effects of the postharvest treatments (2009) on the acidity, brix, juice and taste of keprok Siompu after 21 days of storage.

Table 7. Effects of the postharvest treatments (2010) on the acidity, brix, juice and taste of keprok Siompu after 0 day of storage.

Treatments	Variables			
	Acidity	Brix	Juice	Taste
Control	1.45[a]	7.55[a]	46.52[a]	3.25[a]
Degreening	1.55[a]	7.35[a]	49.89[a]	3.50[a]
Waxing	1.54[a]	7.35[a]	45.93[a]	2.75[a]
Deg + Wax	1.28[a]	1.28[a]	47.70[a]	3.50[a]

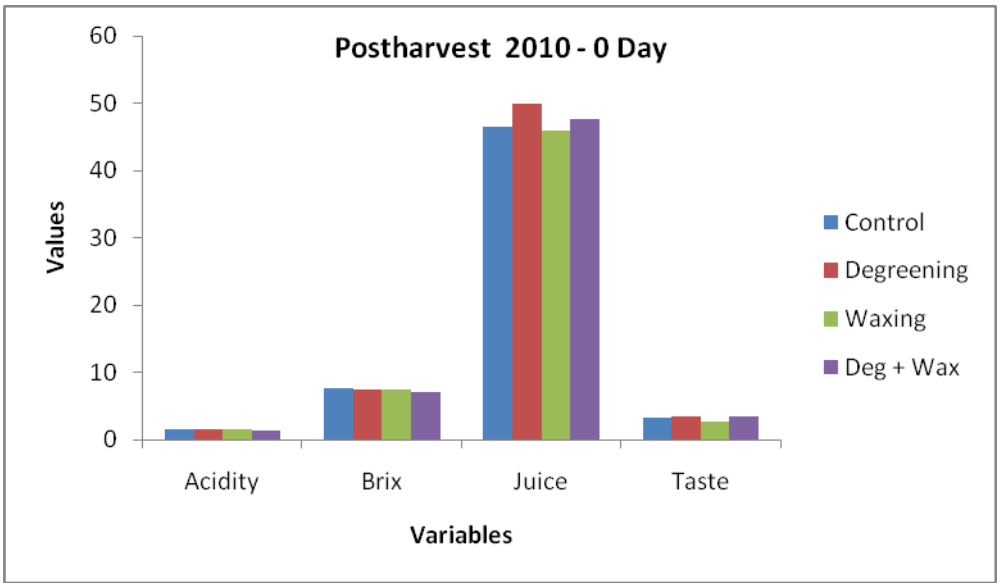


Figure 7. Effects of the postharvest treatments (2010) on the acidity, brix, juice and taste of keprok Siompu after 0 day of storage.

Table 8. Effects of the postharvest treatments (2010) on the acidity, brix, juice and taste of keprok Siompu after 7 days of storage.

Treatments	Variables			
	Acidity	Brix	Juice	Taste
Control	1.30[a]	7.08[a]	48.02[b]	4.00[a]
Degreening	1.21[a]	7.40[a]	57.64[a]	3.75[a]
Waxing	1.35[a]	7.38[a]	45.79[b]	4.50[a]
Deg + Wax	1.41[a]	7.03[a]	46.28[b]	5.00[a]

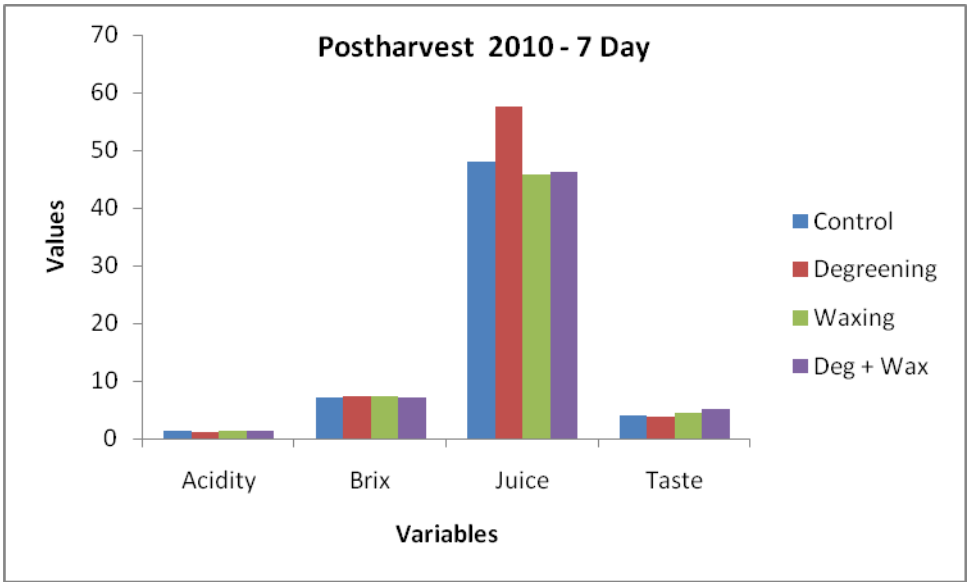


Figure 8. Effects of the postharvest treatments (2010) on the acidity, brix, juice and taste of keprok Siompu after 7 days of storage.

Table 9. Effects of the postharvest treatments (2010) on the acidity, brix, juice and taste of keprok Siompu after 14 days of storage.

Treatments	Variables			
	Acidity	Brix	Juice	Taste
Control	1.20[a]	7.48[a]	49.03[a]	3.25[a]
Degreening	1.12[a]	7.28[a]	48.92[a]	3.75[a]
Waxing	1.34[a]	7.20[a]	47.96[a]	3.50[a]
Deg + Wax	1.24[a]	7.28[a]	47.32[a]	3.75[a]

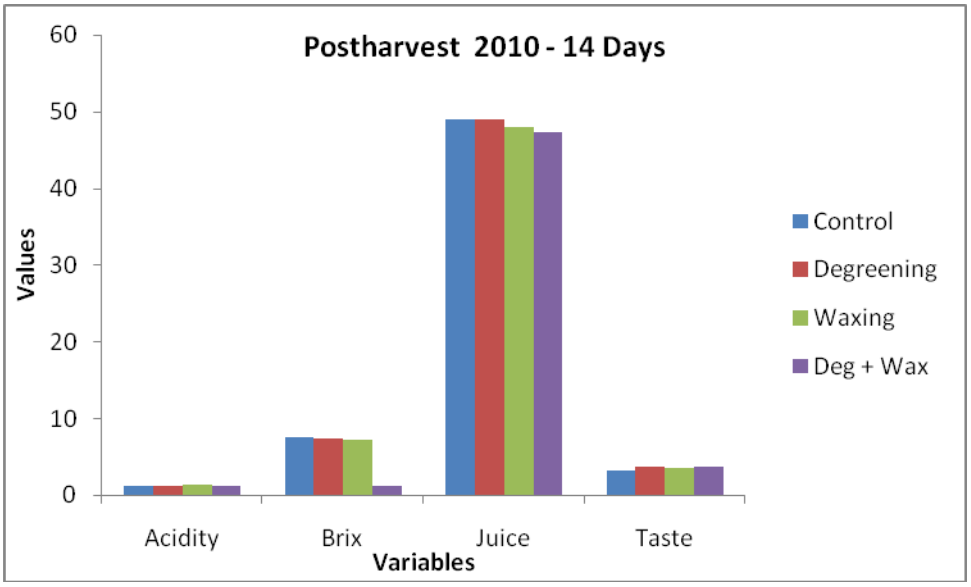


Figure 9. Effects of the postharvest treatments (2010) on the acidity, brix, juice and taste of keprok Siompu after 14 days of storage.

Table 10. Effects of the postharvest treatments (2010) on the acidity, brix, juice and taste of keprok Siompu after 21 days of storage.

Treatments	Variables			
	Acidity	Brix	Juice	Taste
Control	1.05[a]	7.53[a]	49.15[a]	4.00[a]
Degreening	1.11[a]	6.98[a]	47.14[a]	3.25[a]
Waxing	1.05[a]	7.38[a]	47.47[a]	3.25[a]
Deg + Wax	1.01[a]	7.13[a]	47.48[a]	4.25[a]

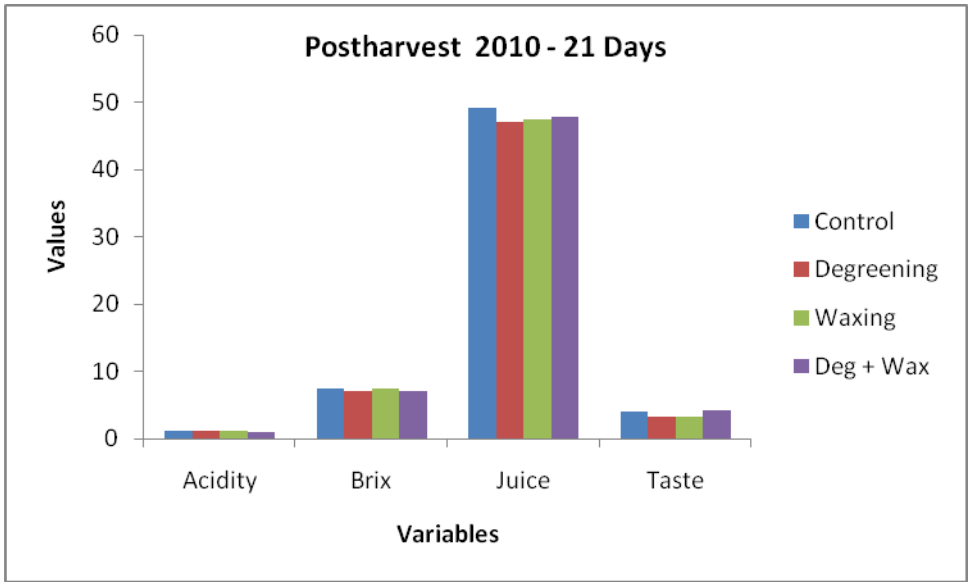


Figure 10. Effects of the postharvest treatments (2010) on the acidity, brix, juice and taste of keprok Siompu after 21 days of storage.

C. Fruit Development

Table 11. Fruit Development of Jeruk Siompu during 2010 Season From February to June

Treatment	Months				
	February	March	April	May	June
Control (mm)	35.83a	42.90a	49.03b	53.11b	57.09b
Treated Trees (mm)	38.17a	45.58a	54.64a	60.18a	65.97a

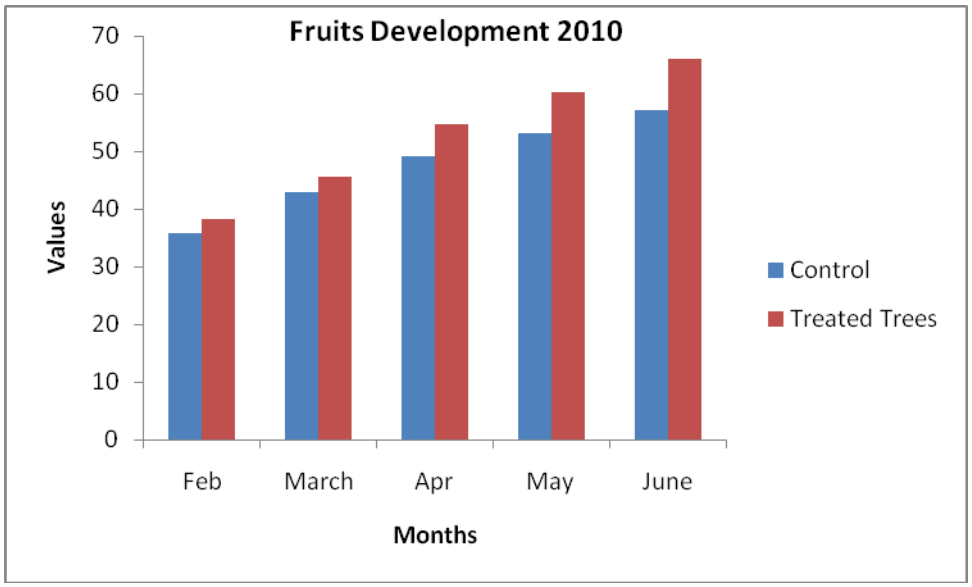


Figure 11. Fruit Development of Jeruk Siompu during 2010 Season From February to June

Describe your Observations

A. Preharvest

Pada Tabel 1 dan Gambar 1 dapat dilihat bahwa aplikasi teknologi prapanen pada tahun 2009 berupa pemupukan, penjarangan buah, pemangkasan dan irigasi menunjukkan ukuran buah yang lebih besar dibanding dengan control. Pada Tabel tersebut nampak bahwa ukuran buah aplikasi prapanen sebesar 64.81 mm secara nyata lebih besar dibanding control yaitu 61.00 mm. Pada tahun 2010, perlakuan prapanen secara konsisten menunjukkan ukuran buah yang lebih besar dibanding tanpa perlakuan. Nampak pada Tabel 2 dan Gambar 2 bahwa ukuran buah pada perlakuan prapanen sebesar 55.75, secara signifikan berbeda dengan control dengan ukuran buah sebesar 51.75 mm. Hal ini mengindikasikan bahwa aplikasi teknologi prapanen baik pada Tahun 2009 maupun tahun 2010 memberikan pengaruh positif terhadap perkembangan ukuran buah, khususnya teknologi penjarangan buah akibat berkurangnya persaingan antara buah dalam pohon yang sama.

B. Postharvest

Pada Tahun 2009, hasil penelitian menunjukkan bahwa tidak terdapat perbedaan nyata antar perlakuan terhadap acidity, juice, brix dan taste pada hari penyimpanan ke-0. Namun demikian, terjadi peningkatan brix dan juice pada perlakuan degreening dan secara signifikan berbeda nyata dengan perlakuan lainnya termasuk control setelah 7 hari penyimpanan pada suhu kamar. Hal ini mengindikasikan bahwa proses degreening memacu pematangan secara lebih cepat dan memberikan pengaruh terhadap variable brix dan juice. Sedangkan perlakuan waxing cenderung menunjukkan brix dan juice lebih rendah dibanding perlakuan lainnya. Hal ini disebabkan karena perlakuan waxing cenderung menghambat proses fisiologis buah jeruk. Kondisi yang sama ditunjukkan pada hari penyimpanan ke 14, dimana perlakuan degreening cenderung memacu brix dan juice dan perlakuan waxing cenderung lebih memperlambat perubahan variable-variabel tersebut. Setelah memasuki penyimpanan hari ke-21, tidak terdapat perbedaan signifikan antara perlakuan baik pada acidity, brix, juice dan taste.

Pada Tahun 2010, kondisi yang sama ditunjukkan pada hari penyimpanan ke-0. Setelah memasuki hari penyimpanan ke-7, maka perlakuan degreening menunjukkan peningkatan juice yang signifikan lebih tinggi dibanding perlakuan lainnya. Namun peningkatan parameter lainnya tidak terdapat perbedaan nyata diantara perlakuan termasuk kontrol. Hal ini berbeda dengan hasil yang ditunjukkan pada Tahun 2009, dimana parameter brix juga menunjukkan perbedaan signifikan pada perlakuan degreening. Pada penyimpanan hari ke-14, tidak terdapat perbedaan signifikan antara perlakuan pada semua variabel pengamatan. Hal ini berbeda dengan hasil yang ditunjukkan pada Tahun 2009, dimana perlakuan degreening cenderung memacu proses fisioloigis buah, dan waxing cenderung menghambat. Pada penyimpanan hari ke-21, keseluruhan perlakuan menunjukkan fenomena yang serupa dengan penyimpanan hari ke-14.

C. Fruit Development

Pengamatan fruit development dilakukan satu musim buah, yakni pada Tahun 2010. Hasil pengamatan menunjukkan bahwa tidak terdapat perbedaan ukuran buah antara control dan pohon perlakuan (aplikasi pemupukan, penjarangan buah, pemangkasan dan irigasi) pada awal pengukuran (bulan ke-3 sejak buah jadi). Fenomena yang sama ditunjukkan pada pengukuran bulan berikutnya (bulan ke-4). Namun setelah memasuki bulan ke-5 (April) hingga bulan ke-7 (Juni), maka pohon yang diperlakukan menunjukkan perbedaan ukuran buah jika dibandingkan dengan kontrol. Hal ini mengindikasikan bahwa terjadi perkembangan buah yang lebih menguntungkan jika dilakukan aplikasi teknologi pra-panen sebagaimana disebutkan terdahulu. Signifikansi perkembangan ukuran buah tersebut terjadi ssetelah memasuki bulan ke-5, ke-6 dan ke-7 sejak buah jadi.

Discussion

What worked well?

Pada prinsipnya teknologi yang dintroduksikan diterima dengan baik oleh petani koperator. Namun teknologi yang paling diandalkan petani untuk dapat dikembangkan adalah pemangkasan, khususnya pemangkasan bentuk dan pemeliharaan.

What did not work and why?

Teknologi yang agak kurang berjalan ditingkat petani adalah pelaksanaan pemupukan secara kontinyu. Meskipun kegiatan ini berjalan dengan baik selama ini, namun harus sedikit dipaksakan. Hal lain yang tidak berjalan baik adalah irigasi pohon, karena sulitnya memperoleh sumber air. Penjarangan buah juga agak sulit diterima petani karena mereka masih mengandalkan jumlah buah disbanding kualitas buah.

How would you do this work better next time?

Permaslahan yang dihadapi selama berlangsungnya kegiatan perlu ditangani dengan melakukan sosialisasi dan penyuluhan secara kontinyu, disamping adanya jaminan pasar bagi buah-buah yang memiliki kualitas baik. Hal ini akan memotivasi petani untuk melakukan aplikasi teknologi yang diintroduksi.

What did you learn from this work?

1. Aplikasi teknologi prapanen dan pasca panen, khususnya pengetahuan dari studi banding di Australia sangat banyak menambah wawasan berfikir dalam mengembangkan buah jeruk di Sulawesi Tenggara termasuk aspek pemasarannya.
2. Pelaksanaan kegiatan khususnya aplikasi teknologi di tingkat petani masih memerlukan sosialisasi yang intensif, disamping penyesuaian terhadap teknologi-teknologi yang masih dianggap baru oleh petani karena masih agak sulit untuk diaplikasikan secara langsung dan berkesinambungan.

How can this work benefit the farmers?

Kegiatan ini cukup menarik bagi petani karena terdapat teknologi-teknologi yang secara langsung dapat memperbaiki kualitas buah jeruk petani, namun perlu diikuti dengan jaminan pasar terhadap produksi yang dihasilkan setelah mereka menerapkan teknologi yang diintroduksikan.

Appendices

No.	Kegiatan	Waktu Pelaksanaan	Partisipan
1	- Kunjungan dan identifikasi lokasi pelaksanaan kegiatan di kabupaten Buton Sulawesi Tenggara - Diskusi dengan petani jeruk keprok Siompu di Buton Sulawesi Tenggara	Petani Jeruk keprok Siompu di Buton, Tim Aciar, BPTP Sultra, Penyuluh Pertanian Buton	Juli 2008
2	- Penentuan pohon sampel/labelling - Pemangkasan dan pemupukan	Petani Jeruk keprok Siompu di Buton, BPTP Sultra, Penyuluh Pertanian Buton	Nopember 2008
3	- Kunjungan ke petani di Buton	Petani Jeruk keprok Siompu di Buton, BPTP Sultra, Penyuluh Pertanian Buton	Maret 2009
4	- Pengambilan sampel jeruk - Analisa kimia/fisik buah jeruk Siompu di Laboratorium	Petani Jeruk keprok Siompu di Buton, BPTP Sultra, Penyuluh Pertanian Buton	Mei 2009
5	- Survei rantai pasar jeruk Siompu	Petani jeruk Buton, BPTP Sultra, Pedagang jeruk Siompu, BPTP Jatim	Juli 2009
6	- Pengamatan fase berbunga dan buah pentil - Pemupukan dan pemasangan bambu air	Petani jeruk Buton, BPTP Sultra, Penyuluh Pertanian Buton	Nopember 2009
7	Pengamatan jumlah buah jadi	Petani jeruk Buton, BPTP Sultra, Penyuluh Pertanian Buton	Desember 2009
8	- Sampling dan pengukuran buah jeruk - Pemangkasan bentuk dan pemeliharaan.	Petani jeruk Buton, BPTP Sultra, Penyuluh Pertanian Buton, Balitjestro Malang	Pebruari 2010
9	Pemangkasan, identifikasi waktu panen dan pengukuran buah	Petani jeruk Buton, BPTP Sultra, Penyuluh Pertanian Buton	Mei 2010

10	Pengambilan sampel untuk analisis Laboratorium Kendari dan proses waxing di Makassar	Petani jeruk Buton, BPTP Sultra, Penyuluh Pertanian Buton	Juni 2010
11	Aplikasi Pemupukan dan Pemangkasan	Petani jeruk Buton, BPTP Sultra, Penyuluh Pertanian Buton	Juli 2010
12	Aplikasi Pemupukan dan Pemangkasan	Petani jeruk Buton, BPTP Sultra, Penyuluh Pertanian Buton	Nopember 2010

Gambar 1. Kegiatan uji organoleptic

Gambar 2. Pengukuran lingkar buah

Gambar 3. Pengukuran kandungan jus

Gambar 4. Panen buah jeruk menggunakan teknologi Introduksi

Gambar 5. Pengukuran perkembangan buah

Gambar 6. Proses degreening buah jeruk

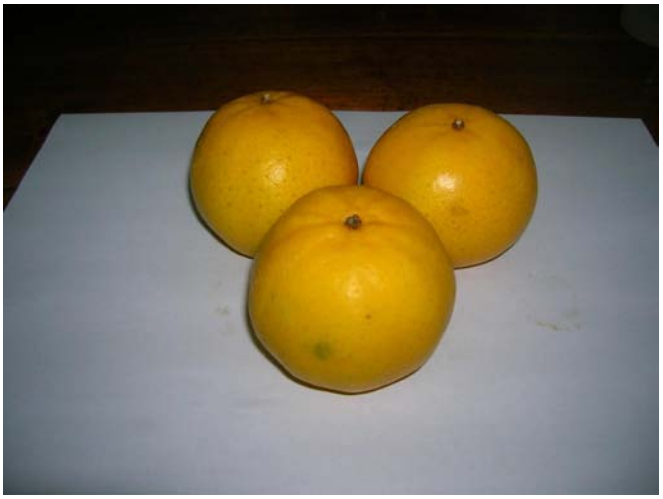
Gambar 7. Kondisi pembuahan jeruk

Gambar 8. Panen buah jeruk secara tradisional

Gambar 9. Pengukuran keasaman buah jeruk

Gambar 10. Kegiatan pemupukan pohon jeruk

Gambar 11. Kunjungan Tim ACIAR



Gambar 12. Kondisi buah jeruk setelah degreening

Gambar 13. Kondisi buah jeruk setelah waxing

Title	**Project Demonstration Plot Report**
Project	**Market development for citrus from Eastern Indonesia**
Project no.	SMAR/2007/196
Research program manager	David Shearer
Project leader	Dr. Peter Taverner
Project coordinator	Dr. Hardianto, MSc.
Sub coordinator Project in South Sulawesi	Ir. Wanti Dewayani
Organisation	Assessment Institute for Agricultural Technology South Sulawesi (AIAT) (Balai Pengkajian Teknologi Pertanian, Sulawesi Selatan)

Australian Government
Australian Centre for International Agricultural Research

Project outline

project number	SMAR/2007/196
project title	Market Development for Citrus from Eastern Indonesia
ACIAR program area	Support for Market-Driven Adaptive Research (SMAR).
commissioned organisation	South Australian Research and Development Institute (SARDI)
project type	Bilateral, Medium
geographic region(s)	South Asia
country(s)	Indonesia
project duration	3 years
proposed start date	1 February 2008
proposed finish date	31 January 2011
time to impact	Category 1

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SUMMARY

South Sulawesi is the main citrus producing province in Eastern Indonesia with 157,783 tons in 2005 from 6,700 hectares, up from 75,791 tons in 1999; a 108% increase. The major keprok citrus production regions are in the southern of South Sulawesi in the four regencies such as Jeneponto, Bantaeng, Bulukumba and Selayar island (known as keprok selayar). These regencies produce about 13,000 tons of keprok citrus from about 2,528 hectares; representing 88% of all keprok citrus production. The main problems with citrus in the Southern region are: Low productivity compared to other regions, Low price paid to farmers (Rp500 per kg – Rp800 per kg) and weak farmer power, Inferior fruit quality – too small, green, watery, a little bit of a sour taste, CPVD – needs to be eradicated and this problem is in all districts, *Diplodia,* Scale insects, Lack of fertilizers being applied – therefore small sized fruit, seeds – many viruses. Many activities could done to help growes to produce superior fruit quality such as extra fertilizer, prunning, thinning, manual pesticide and disease control and clipping techniques. After harvest, it be could activities to retain the fruit quality such as waxing and using sanitiser and fungicide and how to learn degreening method. The activity was conducted on many regencies such as Bantaeng, Jeneponto and Selayar island in South Sulawesi from January till August 2010. Keprok citrus has only one harvest period such as July and August. The activity has conducted suh as crop load, fruit quality testing from treatment the best practice and traditional, wax trials, assesment of various fungicide and salt concentration, degreening trial of keprok Selayar. The result showed that 1) The best practice treatment has average fruitlets 2.5 – 4.5 in Bantaeng and 2.25-7.25 fruitlets in Jeneponto. Whereas the traditional practice has average fruitlets 1-8 in Bantaeng and 3-8.25 fruitles in Jeneponto. As a guide if the average fruit count is greater than about 8-10 fruitlets per frame for oranges or for imperial mandarins 8-10 fruitlets per frame, then thinning should be beneficial. Weight fruit, brix and ratio brix and acid showed that the best practice treatment has better than the traditional treatment in Bantaeng and Jeneponto and significant different. The best practice treatment produce the best quality of fruit that have the highest weight fruit (179.0 g in Bantaeng and Jeneponto), brix (10.63^{o}Brix in Jeneponto and 9.8^{o}Brix in Bantaeng) and ratio brix and acid (12.15 in Jeneponto and 9.4 in Bantaeng). 2) Wax has interaction effect significantly with refregerated and variety treatment on vitamin C, weight loss and juice percentage. Besides, wax has interaction effect significantly with refregerated treatment only such on colour, size and acidity fruit. But brix and ratio brix and acid has not given significant effect all of treatments. 3) The best quality as keprok Siompu wax refregerated with the highest of vitamin C (128.85 mg/100 g sample), juice (42.44%), green colour, size of fruit (66.5 mm) and the lowest weight loss (2.47%). 4) Sanitiser could press of sour rot development. whereas control as water only caused keprok be attacked by sour rot until 91.66% at 20 days. Sanitisers as soda ash 3%, sodium bicarbonate + sodium hipoclorite and fungiside as Dithane or both sanitiser and fungicide (Dithane + soda ash) could significantly improve the quality of fruit going to export market. 5) The green colour of citrus fruit could be changed to yellow colour by ethrel, but percentage of juice to become decreasing. Degreening with dip ethrel 1 000 ppm and waxing gave the best quality and it has yellow colour, 9.10 ^{o} Brix, ratio sugar and acid 13.79, juice 29.61 % and vitamin C 107.37 mg/100 ml sample.

Key words : citrus, fruit quality and keprok Selayar variety

RINGKASAN

Sulawesi Selatan merupakan propinsi penghasil utama jeruk di kawasan Indonesia Timur dengan produksi 75.791 t pada tahun 1999 menjadi 157.783 t tahun 2005. Hal ini terjadi peningkatan 108%. Daerah produksi jeruk keprok umumnya di bagian selatan Sulawesi Selatan pada 4 kabupaten yaitu Jeneponto, bantaeng, Bulukumba dan pulau Selayar. Di kabupaten-kabupaten tersebut dapat memproduksi 13.000 t jeruk keprok dari 2.528 ha atau 88% dari seluruh produksi jeruk keprok. Masalah utama jeruk di Sulawesi Selatan antara lain produktivitas rendah dibanding daerah lain, harga jual rendah di tingkat petani(Rp.500 – Rp. 800 per kg) dan petani tidak mempunyai kekuatan, kualitas buah rendah – terlalu kecil, warna hijau, berair, agak pahit dan asam, terserang penyakit CVPD – masalah pada semua daerah, penyakit diplodia, serangan hama, pemupukan tidak mencukupi kebutuhan tanaman – menyebabkan ukuran buah kecil, benih – mengandung virus. Tujuan pengkajian ini antara lain membantu petani menghasilkan buah jeruk berkualitas, mendapatkan buah yang berpenampilan baik dan tahan lama disimpan, memndapatkan formula untuk memperpanjang masa simpan buah. Penelitian dilaksanakan pada bulan Januari – Desember 2010. Hasil kegiatan menunjukkan bahwa 1)dari hasil forecasting diketahui bahwa perlakuan sesuai rekomendasi mempunyai rata-rata jumlah buah aktual per pohon 2.5 – 4.5 di Bantaeng dan 2.25-7.25 buah aktual di Jeneponto. Sedangkan perlakuan tradisional mempunyai buah aktual rata-rata 1-8 per pohon di Bantaeng dan 3-8.25 di Jeneponto. Berat per buah, brix dan ratio brix dan asam menunjukkan bahwa perlakuan rekomendasi lebih baik daripada tradisional baik di Jeneponto maupun di Bantaeng. Perlakuan rekomendasi mampu menghasilkan buah dengan kualitas terbaik yaitu berat buah 179.0 g di Bantaeng dan Jeneponto, 10.63^{o}Brix di Jeneponto dan 9.8^{o}Brix di Bantaeng, ratio brix and acid (12.15 di Jeneponto dan 9.4 di Bantaeng). 2) Pada perlakuan pelilinan pelilinan ada interaksi nyata antara pelilinan, suhu penyimpanan dan varietas terhadap kadar vitamin C, susut bobot dan jumlah sari buah. Dipihak lain, ada interaksi nyata antara suhu penyimpanan dan pelilinan terhadap warna, diamter dan keasaman, namun brix dan rasio brix/asam tidak berbeda nyata. Hasil menunjukkan jeruk keprok Siompu yang dililin dan disimpan pada suhu dingin memberikan kualitas buah terbaik dengan kadar vitamin C (128.85 mg/100 g sample), juice (42.44%), diameter buah (66.5 mm)dan susut bobot terendah (2.47%). 4) Sanitiser dapat menekan perkembangan penyakit busuk asam. Pencucian dengan air (kontrol) menyebabkan buah jeruk keprok terserang hingga 91.66% pada saat penyimpanan 20 hari. Sanitiser seperti soda ash 3%, sodium bicarbonate + sodium hipoclorite dan fungisida dan kombinasi dengan sanitiser (Dithane + soda ash) secara nyata dapat menekan penyakit busuk asa untuk pasar ekspor. 5) warna hijau pada kulit buah jeruk dapat dirubah menjadi kuning orange dengan perlakuan ethrel, Degreening dengan pencelupan dalam larutan ethrel 1000 ppm dan dililin memberikan hasil terbaik dengan warna kuning orange, kadar gula 9.10 ^{o} Brix, nisbah gula asam 13.79, juice 29.61 % dan vitamin C 107.37 mg/100 ml sample.

Kata kunci : jeruk, kualitas buah dan varietas keprok Selayar

INTRODUCTION

South Sulawesi is the main citrus producing province in East Indonesia with 157,783 tons in 2005 (60% share) up from 75,791 tons in 1999. However, South Sulawesi's share of citrus production in Indonesia has declined from 16.9% to 7.1% over the last 6 years. The major citrus regions are in the north of South Sulawesi, representing 88% of all siam/keprok citrus production.

South Sulawesi is the main citrus producing province in Eastern Indonesia with 157,783 tons in 2005 from 6,700 hectares, up from 75,791 tons in 1999; a 108% increase. However, South Sulawesi's share of citrus production in Indonesia has declined from 16.9% to 7.1% over the last six years.

During this period, citrus yield has increased from 17.2 tons to 23.4 tons per hectare; however this is below the average in Indonesia of 33 tons per hectare.

The major keprok citrus production regions are in the southern of South Sulawesi in the four regencies such as Jeneponto, Bantaeng, Bulukumba and Selayar island (known as keprok selayar). These regencies produce about 13,000 tons of keprok citrus from about 2,528 hectares; representing 88% of all keprok citrus production.

The main problems with citrus in the Southern region are Low productivity compared to other regions, low price paid to farmers (Rp500 per kg – Rp800 per kg) and weak farmer power, inferior fruit quality – too small, green, watery, a little bit of a sour taste, CPVD – needs to be eradicated, *Diplodia,* Scale insects, lack of fertilizers being applied and therefore small sized fruit (Morey, 2007).

Citrus fruit produced in south sulawesi is often mature and of acceptable eating quality when the rind is still green. High temperatures and humidity interfere with peel coloration, although internal fruit quality characteristics may be acceptable. Regardless of peel color, local consumers recognize citrus fruit with a green peel color may be perfectly good to eat. Domestic consumers tend to be more concerned about citrus fruit flavor and juiciness, rather than external appearance. However, many consumers in South Sulawesi believe keprok with green- colored peels are immature and not ready to eat. Demand in these markets is only for fully colored citrus fruits. In order to improve external skin color and export market acceptance, citrus can be treated with ethylene, which is a naturally produced plant growth hormone effective as a de-greening agent (Anonym, 2004).

The local Ministry of Agriculture (Dinas) works with farmer groups via the local extension officer (EO) to tackle technical issues. But until now, growers still produce inferior fruit quality. So, the growers still receive a few money from citrus.

Many activities could done to help growes to produce superior fruit quality such as extra fertilizer, prunning, thinning, manual pesticide and disease control and clipping techniques. After harvest, it be could activities to retain the fruit quality such as waxing and using sanitiser and fungicide and how to learn degreening method.

AIM

The objective of this research is

- To help growes to produce superior fruit quality
- To discover the best performance of fruit and making of longer fruit strore
- To discover the best formula in the making of longer fruit strore

METHODS

The activity was conducted on many regencies such as Bantaeng, Jeneponto and Selayar island in South Sulawesi from January till August 2010. Keprok citrus has only one harvest period such as July and August. In Jeneponto, keprok was harvested on end of July and in Bantaeng on middle August.

REGIONS

1. Pak Mansur trees, Balangloe Village, Jeneponto Regency, Southern Sulawesi
2. Pak Rasing trees, Campagaloe Village, Bantaeng Regency, Southern Sulawesi

SITE PLANT

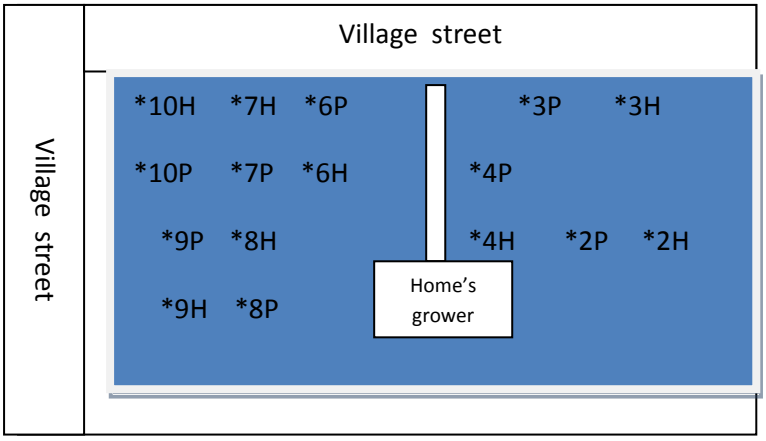

Figure 1. Site plan in Bantaeng Regency

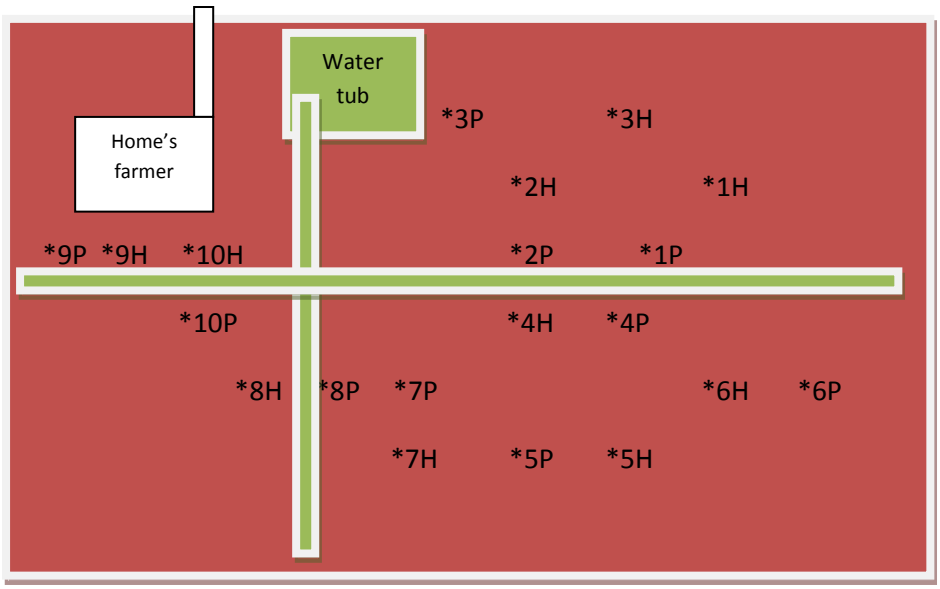

Figure 2. Site plan in Jeneponto Regency

Experimental Procedures

1. Crop Management

The activity in grower tree was two treatments. In Bantaeng, chosen 8 trees as best practice treatment and 8 trees as traditional treatment. Whereas in Jeneponto, chosen 10 trees as best practice treatment and 10 trees as traditional treatment.The best practice treatment (*H tag) involves the use of extra fertilizer, prunning, thinning, manual pesticide and disease control, clipping techniques, waxing and stored in cool room.

The traditional treatment (*P tag) using grower methods with traditional technology as commonly used by growers where there was no fertilizer, no prunning, no thinning and no control to pest and disease and never use clip to harvest fruit, no waxing and store in normal temperature (please look at site plan).

The observation on agronomic performance every month involve fruit size measured by sizing ring. Crop load measured by counting frame begun on April till July. The counting frame (0.5 m x 0.5 m x 0.5 m) made from 10 mm square aluminium steel with 0.5 m prongs at each corner. The counting frame is four sites (north, west, south and east) placed in the canopy with prongs pointing towards the trunk and outer edge of the frame at the canopy, at a height between 1.0-2.5 m from the ground.

On harvest season, there were three groups of keprok collected and brought at the laboratory BPTP in Makassar. One group be used for wax trails. The second lot of keprok is collected from the 8 trees at Bantaeng and ten trees at Jeneponto were used for fruit

quality assessment. The third group of keprok was used for sanitiser trails. 20 fruit will be collected from each tagged (total of 16 trees from Bantaeng and 20 trees from jeneponto).

2. Post Harvest Management in Laboratory

The fruit from each tree was kept separate for assesment. All fruit be estimated using the colour chart. Selected 3 groups of 4 fruit each (total 12 fruits) from each tagged tree. Each group of 4 fruit be weighted, juiced and mixed together. The 3 lots of juice be assessed for the following :

- Juice content be measured using scales (fruit weight in grams) and measuring cylinder (juice volume in milliliters)
- % acid be measured using a burette, phenolpthalein indicator and 0.1 N sodium hydroxide solution and 200 ml flask
- Sugar content (Brix) using a refractometer
- Fruit taste be measured using a simple taste preference method
- Vitamin C be measured in another institution
- The above tests be repeated for the fruit each tagged tree

Procedure for Measuring the % Acid of Citrus Juice

Equipment

- 200ml Erlenmeyer flask
- 50 ml Burette with stand
- Phenolphthalein indicator solution
- N Sodium Hydroxide (NaOH) solution 0.1 N

Method

- Transfer 10 ml fruit juice to a 200 ml Erlenmeyer flask
- Add 5 drops of phenolphthalein indicator.
- Titrate with a 0.1 N sodium hydroxide from a 50 ml burette. Use a white tile or white paper under the Erlenmeyer flask so as to see the endpoint more clearly. The contents of the Erlenmeyer should be constantly mixed during the titration. An easy method is to operate the tap of the burette with the left hand and swirl the contents of the Erlenmeyer counter-clockwise with the right hand holding the neck of the Erlenmeyer. When the endpoint is approached the solution in the Erlenmeyer shows a streak of pink arising from the point where the sodium hydroxide enters the juice. This becomes

progressively larger as more sodium hydroxide is added, but the pink colour disappears rapidly after it has formed. Continue adding sodium hydroxide drop by drop. The end point of the titration is when the pink colour persists throughout the solution for 5 seconds after the last addition of sodium hydroxide from the burette.

- Read the contents of the burette at the bottom of the meniscus.
- Calculate the percentage as follows:

$$\% \text{ Acid} = \frac{\text{ml of NaOH titrated}}{\text{ml of fruit juice (=10)}} * \frac{\text{Normality of NaOH used (=0.1)}}{\text{Constant (=0.1562)}}$$

$$\% \text{ Acid} = \text{ml of NaOH titrated} * 0.064$$

Notes:

It is necessary to know what the strength (or normality) of the sodium hydroxide solution to calculate the constant value. The normality of the NaOH used MUST be 0.1 N for the constant value to be equal to 0.1562 in the above equation.

Sodium hydroxide solution weakens with storage unless its container is tightly closed because it reacts with the carbon dioxide in the air. Typical % acid value for oranges range from 0.5 to 1.5%.

Measurement of fruit color was conducted on 20 fruits in random. Measurement use color fruit chart as follow:

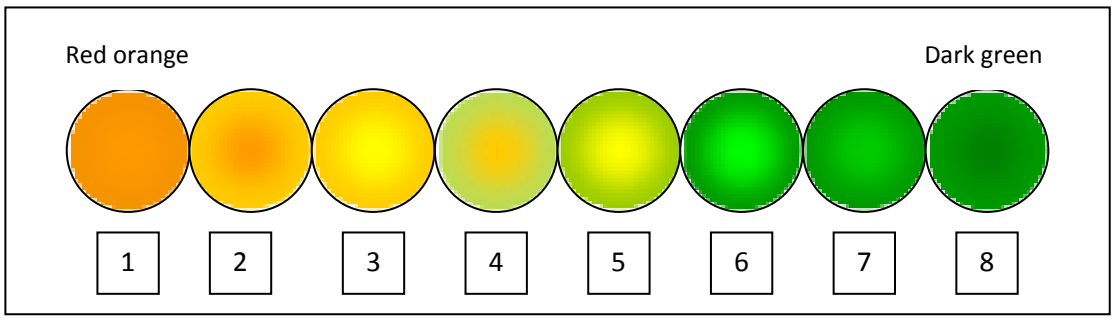

Figure 1. Color fruit chart

The experiment was arranged in randomized complete block design with two factors. The first factor was two sites such as Bantaeng and Jeneponto. The second factor was two treatments such as best practice and traditional practice. Parameter of quality which measured was fisics (weight fruit, colour and juice percentage) and chemical (brix, acid ratio acid and brix and vitamin C).

a. Influence of waxing and variety on quality of keprok fruit

The keprok collected for the wax trials from the best practice trees. The keprok Siompu from Buton (South east Sulawesi) and keprok Selayar from Jeneponto (South Sulawesi). Collected the keprok was same the large, diameter and good quality. The fruit divided for 4 treatments and 2 replications. Each treatment 20 fruits. Materials used were wax, fruit, water, etc. After treatments, fruit stored until 2 weeks and observed of weight loss, color, brix, acid and vitamin C.

Waxing procedure as follows :

- All Keprok checked and sorted into two groups.
- One group of keprok was waxed and another group of keprok unwaxed
- Fruit for Wax treatment is diluted with clean water (50:50) in bucket
- Place fruit into dipping basket and immerse into dilute wax
- Allow to drain and place wet fruit on rack to dry
- After dry, place into plastic crates.
- Keprok has waxed and placed into refregerator and unrefregerator room. The other group was not be waxed and was placed into refregerator and unrefregerator room.

The experiment was arranged in randomized complete block design with two factors. The first factor was two waxing teratments. The second factor was two refregerated treatments such as refregerated and unrefregerated. Parameter of quality which measured was fisics (weight loss (%), size, colour and juice percentage), chemical (brix, acid ratio acid and brix and vitamin C).

b. Assesment of Various Fungicide and Salt Concentration on the Development of Sour Rot

Materials used were keprok fruit from Bantaeng, water, soda ash, Dithane M-45 80 WP (fungicide, Carbendazim group), Soda bicarbonate, Sodium hypoclorite and wax. Fruit dip in treatment about 5 seconds and drained until dry. Fruit for Wax treatment is immerse into wax. Fruit was allowed to drain and place wet fruit on rack to dry.

Treatments as follow :

a. Control (water only) with waxed and unwaxed
b. Soda ash 0.5% (5 gms/L) with waxed and unwaxed
c. Soda ash 3% (30 gms/L) with waxed and unwaxed
d. Dithane M-45 1 g/L with waxed and unwaxed
e. Dithane M-45 80 wp + soda ash 0.5 % with waxed and unwaxed

f. Dithane M-45 80 wp + soda ash 3 % with waxed and unwaxed

g. Soda Bicarbonate 2% (20 g/L) + 1.5% Sodium Hypoclorite (120 ml/L) with waxed and unwaxed

After treatments, fruit stored and observed every 5 days until 20 days, about health and decay fruit. Each treatment consisted of 30 fruits with three replicates.

The experiment was arranged in randomized complete block design with two factors. The first factor was two waxing (wax and unwax) teratments. The second factor was seven salt concentrations. Parameter measured was the development of sour rot.

c. Degreening Trial of Keprok Selayar

Citrus fruit from Selayar Island taken to laboratory AIAT Makassar and tried with some treatments such as :

a. Unwaxing and Undegreening

b. Unwaxing and Degreening with ethrel 1000 ppm

c. Unwaxing and Degreening with ethrel 2 000 ppm

d. Waxing and Undegreening

e. Waxing and Degreening with ethrel 1000 ppm

f. Waxing and Degreening with ethrel 2 000 ppm

After dry, placed into plastic crates and stored until yellow. Each treatment 10 fruits and 3 replicates.

The experiment was arranged in randomized complete block design with two factors. The first factor was two waxing teratments such as waxing and unwaxing. The second factor was degreening treatments such as undegreening, degreening with ethrel 1000 ppm, degreening with ethrel 2000 ppm. Parameter of quality which measured was colour, acid, brix, acid ratio acid and brix, vitamin C and juice percentage.

Equipment

- 100 kg good quality keprok
- Wax
- Bucket (5 L) for dipping fruit in wax
- Dipping basket
- Gloves
- Drying racks
- Racks for placing fruit
- Labels

- Plastic crates
- Knife
- Laboratory scale for weighing keprok
- Refractometer
- Burette, phenolphthalein indicator and 0.1 N sodium hydroxide solution and 200 ml flask
- Cool storage
- Ring or caliper for measuring keprok
- Measuring cilinder or beaker (100 mls)
- Citrus Juicer
- Water, soda ash, Dithane M-45 80 WP (fungicide, Carbendazim group), Soda bicarbonate, Sodium hypoclorite
- Colour scale
- Counter frame
- Clipping
- Ethrel

Involving Growers

1. Introduction visiting to The local Ministry of Agriculture (Dinas Pertanian) in Bantaeng and Jeneponto regencies
2. Head of Ministry of Agriculture ask for local extension to chose grower who follow this activity
3. 10 growers in Jeneponto and Bantaeng with two sites experiment locations such as Pak rasing trees and Pak Mansur Trees
4. The growers held when plotting. They knew plot of best practice (green tag) and plot traditional plot (white tag).
5. The growers tried to prunning, fertilizing and thinning, after Pak Adi Cahyono (technician) trained them

RESULT AND DISCUSSION

1. **Crop Management**

a. Crop Load

Assessing crop load is essential in making the right management decision to achieve the best fruit size. It is particularly useful when there is a heavy crop load as it

allows to undertake suitable crop load reduction strategies such as chemical or hand thinning.

In Figure 1 and 2 showed that the best practice treatment has average fruitlets 2.5 – 4.5 in Bantaeng and 2.25-7.25 fruitlets in Jeneponto. Whereas the traditional practice has average fruitlets 1-8 in Bantaeng and 3-8.25 fruitles in Jeneponto. As a guide if the average fruit count is greater than about 8-10 fruitlets per frame for oranges or for imperial mandarins 8-10 fruitlets per frame, then thinning should be beneficial.

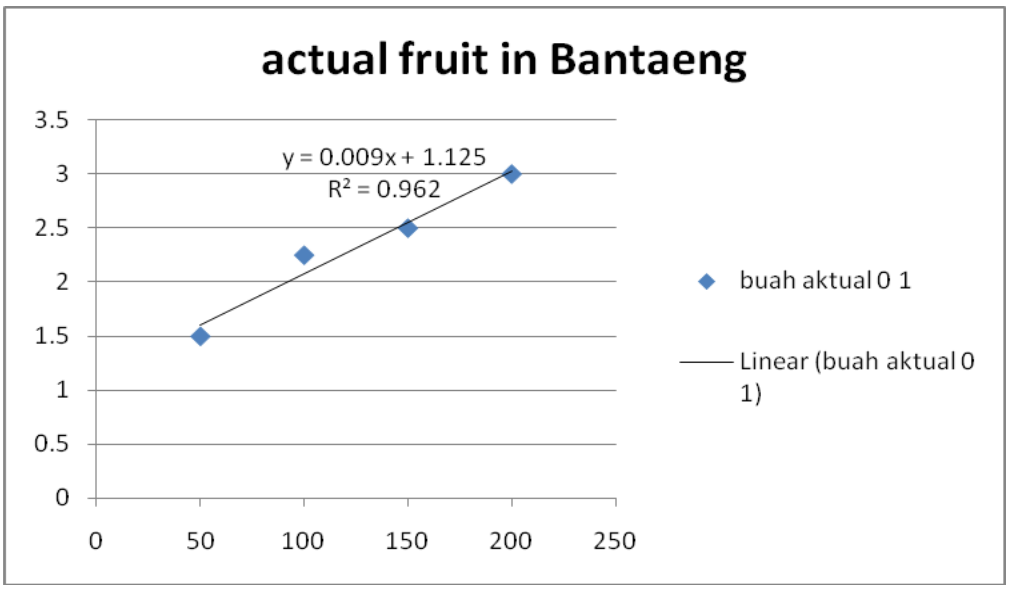

Figure 1. fruit forecasting in Bantaeng Regency

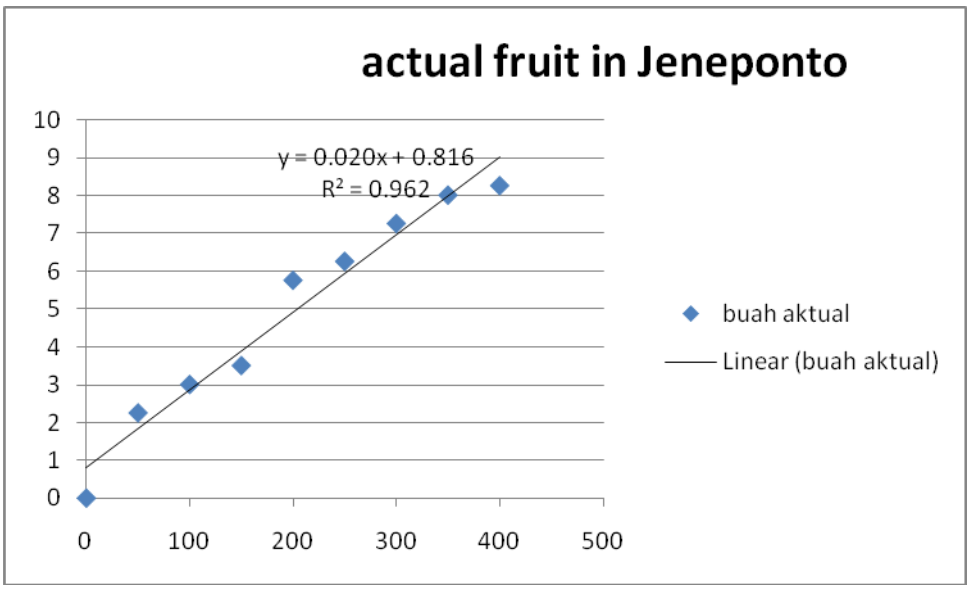

Figure 2. fruit forecasting in Jeneponto Regency

b. Agronomic Performance

Keprok performance involve tree age, diameter of stem and scion, height of tree, wide of canopy, fruit number per tree, weight fruit, size, color, brix, percentage of juice, acid and vitamin C were showed on Table 1 and Table 2

Table 1. Performance of fruit quality after harvest in Bantaeng

Observation	Best practice	Traditional	Statistical analysis
Age (years)	6 a	6 a	Ns
Stem Diameter	63.95	63.36	Ns
Scion Diameter	49.89	47.79	Ns
Height	322.625	321.5	Ns
Wide of canopy north-south	98.125	97.2	Ns
Wide of canopy east-west	115.125	97.3	Ns
Fruit Number of tree	8.63	17.9	Ns
Weight fruit	179,0 a	108 b	S
Size	70,90 a	67,40 a	Ns
Colour	4,5 a	4,5 a	Ns
^{o}Brix	9,8 a	7,00 b	S
Acid	1,05 a	1,06 a	Ns
Ratio brix acid	9,397 a	6,76 b	S
Juice (%)	34,07 a	26,02 a	Ns
Vitamin C (mg/100 g sample)	93,52 a	81,43 a	Ns

Ns = not significantly different
S = significantly different

Table 2. Performance of fruit quality after harvest in Jeneponto

Observation	Traditional	Best practice	Statistical analysis
Age (years)	6 a	6 a	Ns
Stem Diameter	91.16 a	86.26 a	Ns
Scion Diameter	74.82 a	73.43 a	Ns
Height	315 a	331 a	Ns
Wide of canopy north-south	197.1 a	192.1 a	Ns
Wide of canopy east-west	188.8 a	172.3 a	Ns
Fruit Number of tree	185.9 a	216.0 a	Ns
Weight per fruit	114,67 b	179,0 a	S
Size of fruit	67.4 a	70.9 a	Ns
Colour of fruit	4.0 a	4.5 a	Ns
^{o}Brix	9.13 b	10.63 a	S
Acid	0.93 a	0.91 a	Ns
Ratio brix acid	9.14 b	12.15 a	S
Juice (%)	33.03 a	35.14 a	Ns
Vitamin C (mg/100 g sample)	81.43 a	93.52 a	Ns

On Table 1 and 2 showed that tree age, diameter of stem and scion, height of tree, wide of canopy, weight per fruit, size of fruit, colour of fruit, acid, Juice (%) and vitamin C were not significant between the best practice and traditional practice. But weight fruit, brix and ratio brix and acid showed that the best practice treatment has better than the traditional treatment in Bantaeng and Jeneponto and significant different. The best practice treatment produce the best quality of fruit that have the highest weight fruit, brix and ratio brix and acid.

The best practice treatment worked well such as involves the use of extra fertilizer, prunning, thinning, manual pesticide and disease control and clipping techniques, waxing and stored in cool room. The best practice treatment could produce the best quality in Bantaeng and Jeneponto. But traditional treatment did not worked by growers because it cause many problems. Traditional teratment as commonly used by growers where there was no fertilizer, no prunning, no thinning and no control to pest and disease and never use clip to harvest fruit, no waxing and store in normal temperature.

Most citrus keprok in Jeneponto and Bantaeng are not well cultivated, because of poor knowledges in citrus orchad management including application of manure and agricultural chemical. The owner comes to see the orchad during the harvest season only. As the harvesting time over, the trees are left in poor condition; no fertilizer, or other cultivation activities as prunning and thinning. Therefore under these circumtances, the various diseases damage most citrus trees in Jeneponto and Bantaeng.

Figure 3. Best practice' method in demo plot

Figure 4. Traditional practice' tree in demo plot

Figure 5. Best practice' (rekomendasi) and traditional (cara petani)canopy

Figure 6. Placing the counting frame into the tree

c. Fruit Size

In figure 7 and 8, showed that growth rates keprok fruit Selayar in Bantaeng and Jeneponto. Treatment of the best practice conducted application of fertilizer, manure, prunning and thinning on January. On February occured difference significantly between best practice and traditional treatments. The best treatment could produce keprok with diameter 84.5 mm and the traditiolanl treatment only 72.5 mm, but this size was not significant different.

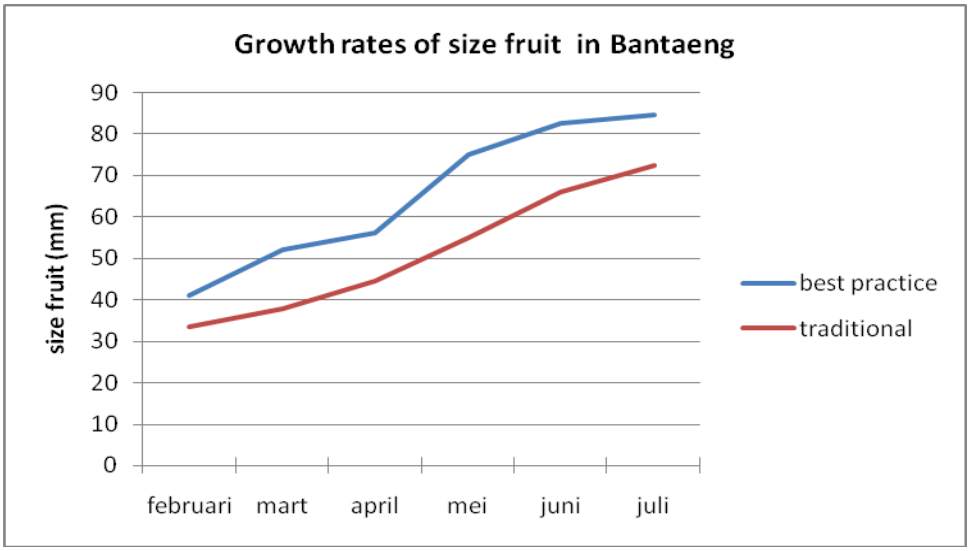

Figure 7. growth rate of size fruit in Bantaeng

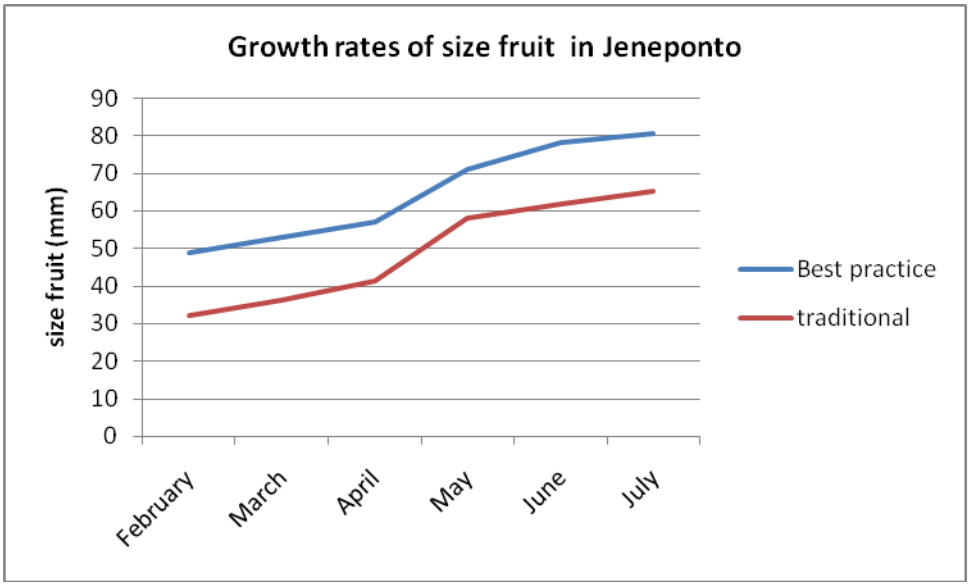

Figure 8. growth rate of size fruit in Jeneponto

Before aplication of fertilizer in best practice treatment, soil and citrus leaf of demoplot both Jeneponto and Bantaeng was analized. Soil and Leaf analysis is an effective technique for monitoring the nutrient status of citrus trees, for anticipating problems, and for providing a guide to the fertiliser program. Result of demoplot soil and leafs in Jeneponto and Bantaeng Regencies showed in appendices no. 3 and 4. Citrus trees are demanding feeders and are prone to many disorders related to mineral nutrition. Citrus species are also sensitive to an excess of certain elements in the

soil or the irrigation water, especially to an excess of chloride, sodium, boron and manganese, which can injure the trees. The leaf analysis result that 2.37% N, 0.44% K of citrus leaf in Jeneponto included low range Leaf in analysis standards for citrus (Appendices No. 4), was considered increasing nitrogen and potassium fertilisers by 100–200 g per tree. Whereas in Bantaeng, the leaf analysis result included high range (2.37% N) and saticfactory range (0.14% P, 0.73% K and 0.44% Mg). If the leaf levels are within the satisfactory range, continue normal fertiliser program (100 g/tree). Where the production of good quality fresh oranges is of prime importance, leaf nitrogen levels should be kept near the lower end of the acceptable range (about 2.4%). Leaf potassium can fluctuate from one season to the next, but if the level remains in the low range (0.4–0.6% K) for two or more seasons, apply extra potassium (Anonym, 2011).

2. **Post Harvest Management**

a. Influence of waxing and variety on quality of keprok fruit

Since there are many different suppliers offering coatings, and each supplier often offering several different coating products, the question of which product is best is of concern to the packinghouse manager. Since there is no single answer to this question, we will consider several factors that affect that decision (Hall, 1981).

Table 4**.** Influence of waxing and variety on quality of keprok fruit after stored 2 weeks

Treatment	Vitamin C	Weight Loss (%)	Juice (%)	Colour	Size mm	Brix	Acid	Ratio Brix:Acid
Keprok selayar Wax refregerated	82.70 bcd	6.95 c	34.05 abc	4.15 ab	67.25 a	8.95 a	0.80 ab	10.75 a
Keprok selayar Wax unrefregerated	67.85 cd	14.15 bc	23.95 d	3.75 ab	67.30 a	9.40 a	0.90 ab	10.35 a
Keprok selayar Unwax refregerated	100.0 abc	13.9 bc	28.6 cd	4 ab	60.1 ab	8.55 a	1.10 a	8.00 a
Keprok selayar Unwax unrefregerated	61.45 d	32.9 a	30.3 bcd	3.15 b	57.95 b	8.45 a	0.85 ab	9.95 a
Keprok Siompu Wax refregerated	128.85 a	2.47 c	42.44 a	4.87 a	66.50 a	7.58 a	0.82 ab	10.61 a
Keprok Siompu Wax unrefregerated	121.14 a	22.16 ab	36.9 abc	3.75 ab	57.50 b	7.50 a	0.84 ab	9.22 a
Keprok Siompu Unwax refregerated	106.73 ab	15.04 bc	38.54 ab	4.75 a	65.5 ab	7.30 a	0.71 ab	11.72 a
Keprok Siompu Unwax unrefregerated	101.92 abc	23.81 ab	36.35 abc	3.75 ab	60.5 ab	7.75 a	0.69 b	11.36 a

On Table 4 showed that, wax has interaction effect significantly with refregerated and variety treatment on vitamin C, weight loss and juice percentage. Besides, wax has interaction effect significantly with refregerated treatment only such on colour, size and acidity fruit. But brix and ratio brix and acid has not given significant effect all of treatments. The best quality as keprok Siompu wax refregerated with the highest of vitamin C (128.85 mg/100 g sample), juice (42.44%), green colour, size of fruit (66.5 mm) and the lowest weight loss (2.47%).

Result waxing treatment has tried on keprok Selayar and keprok Siompu (Table 5). The general condition of refrigerated fruit was much better than the others. The refregerated waxed was superior fruit quality in keprok Selayar and Siompu and have good performane could stored until 2 weeks with good quality. Wax applicated as citrus Lustr 400 is a high shine coating for post harvest application to citrus fruit. The coating will reduce weight loss due to dehydration and serves as a compatible carrier for most fungicides. The product is suitable for application on citrus for export to Japan. The best quality showed that keprok siompu wax refregerated has the higest vitamin C (128.85 mg/100 g sample), the lowest weight loss (2.47%), the highest juice (42.44%) and yhe highest size (66.50 mm).

The desired end result of citrus waxing is to give the fruit a good shine that will last through the marketing process as well as to reduce weight loss by the fruit to the maximum extent possible without harming the fruit (Hall, 1981).

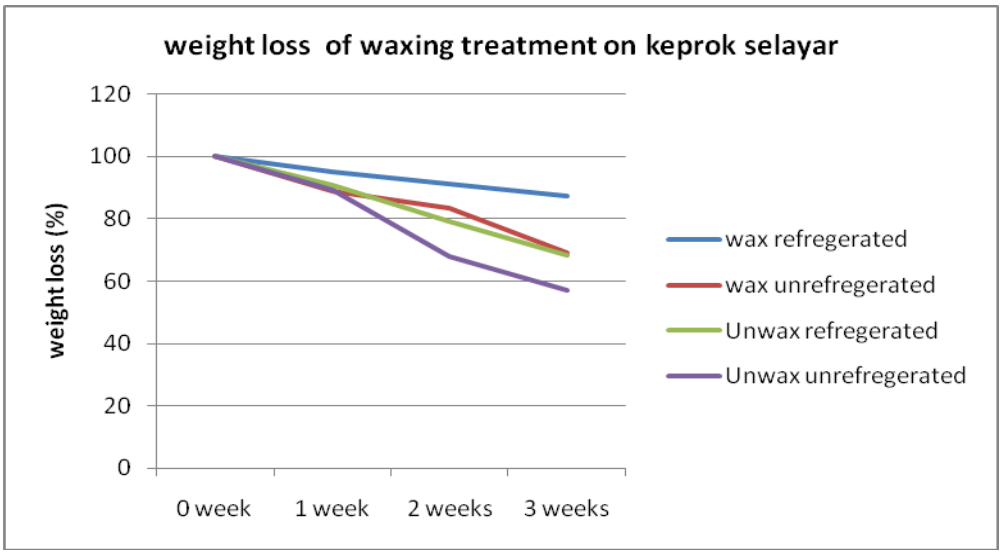

Figure 9. weight loss of waxing teratment on keprok Selayar

In figure 9 showed that wax refregerated treatment has the lowest weight loss compared the others. Wax is very useful for keprok. Wax could improve fruit performance, care fruit from disease and also decrease of weight loss. But wax must be combined with refregerated treatment, because the unrefrigerated fruit treatment has developed symptoms. It has the appearance and odour of sour rot but without a loss of structure (soft and liquefied).

b. Assesment of Various Fungicide and Salt Concentration on the Development of Sour Rot

Sanitation and the use of fungicide and sanitiser has a very important role in controlling fungal spores and potentially harmful bacteria in citrus packingshed dips and reciculating tanks. At Figure 11 showed that sanitiser could press of sour rot development. whereas control as water only caused keprok be attacked by sour rot until 91.66% at 20 days. Sanitisers as soda ash 3%, sodium bicarbonate + sodium hipoclorite and fungiside as Dithane or both sanitiser and fungicide (Dithane + soda ash) could significantly improve the quality of fruit going to export market.

Sodium Bicarbonate significantly reduced the decay incidence throughout 30 d of storage at 10 degrees C with 95% RH and 6 d of simulated marketing period at 25 degrees C and 75% RH. When fruit was treated with SBC, scanning electron microscopy observations evidenced a production of crystalline wax patches with branched stripes and the magnitude was positively correlated to the salt concentration in the mixture (Dore, Molinu, Venditti and D'Hallewin, 2010).

Chlorine based sanitisers are the most widely used sanitisers in the world. In citrus packingsheds the most common form of chlorine used is sodium hypochlorite (common ‘bleach’) or calcium hypochlorite (pool chlorine). The chlorine dissociates in water to form hypochlorous acid – the main antimicrobial ingredient. The amount of hypochlorous acid in any mixture will be dependent on the pH of the solution. When mixed, hypochlorites tend to be in the alkaline range (pH 8-10) with little or no active hypochlorous acid, so buffering is required to bring down to a more neutral pH.

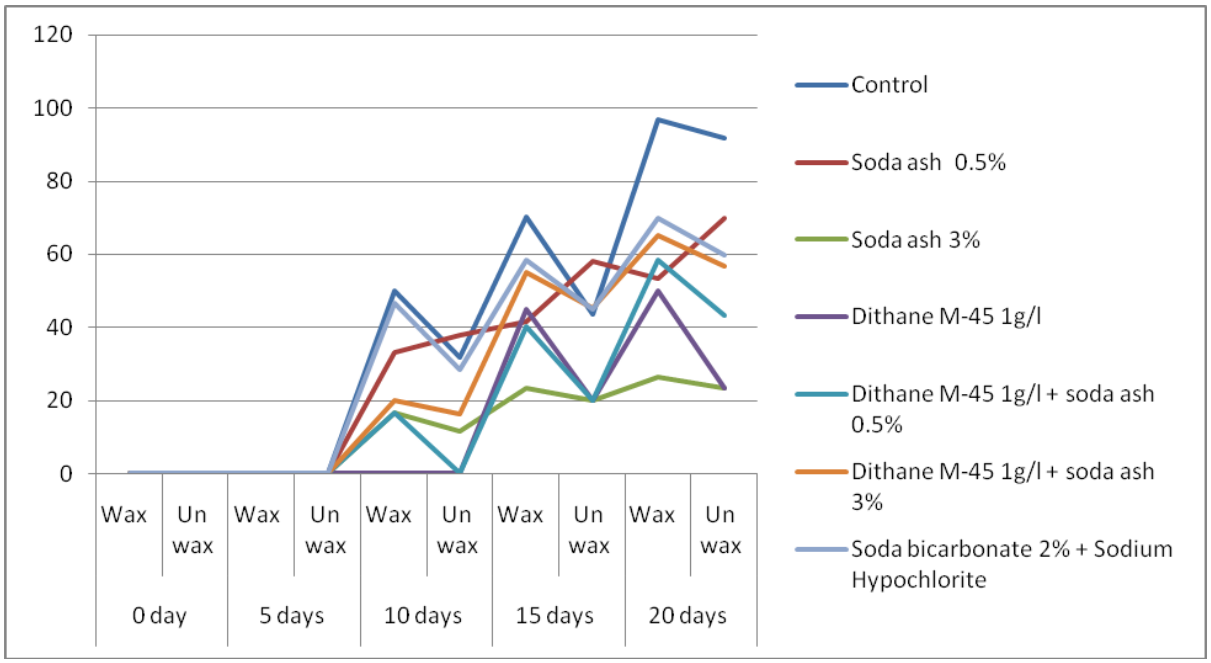

Figure 11. Assesment of various fungicide and salt concentration on the development of sour rot

Fungicides are fungi specific and can kill over a prolonged period (giving added protection for overseas export destinations), but it have residual effect on microbes, so fungicides are not safety to health human.

Unlike fungicides, sanitisers are not specific to any one type of microbe and will kill most microbes on contact (including fungal and bacterial spores). Sanitisers kill only on contact and have no residual effect on microbes. Sanitisers are highly reactive with organic surfaces (fungi, bacteria) but also react with dirt, leaves, and twigs as well as fruit surfaces. Sanitisers can also produce by-products when reacting with organic matter and could possibly cause phytotoxic reactions with fruit surfaces, leading to postharvest blemishes. Many sanitisers, such as sodium hypochlorite, are very effective, cheap and commonly available. Other locally available options, with anti-microbial properties, may also be valuable to consider for grower sanitation programs.

c. Degreening Trial of Keprok Selayar

At present there is only one chemical – ethephon, sold under the trade name Ethrel, registered for thinning citrus (Sandra Hardy and Steven Falivene, 2008). Ethrel is one liquid ethylene that contain ethephon could be used to de-degreening citrus. Ethrel is a growth regulator used in major horticultural crops and cereals. It promotes ripening in tomatoes, reduces curing time and promotes colour development in flue-cured tobacco, accelerates

fruit maturity in apples and blueberries and loosens mature fruit from the stem in cherries for easier harvesting. In cereals, ethrel is used to reduce lodging. Active Ingredients in ethrel is ethephon (Anonym, 2011).

The general procedure for de-greening citrus with liquid ethylene (ethephon) involves dipping green-skinned fruit in a tank of water at ambient temperature to low concentrations of ethylene for several minutes or less.

Table 5. Degreening with ethrel and wax treatment on keprok Selayar

Treatment	Colour scale	Acid	Brix	Ratio brix/acid	Juice (%)	Vitamin C (mg/ 100 ml)
Unwax Undegreening	4.67 a	0.71 bc	8.00 a	11.21 b	22.88 ab	49.13 b
Wax undegreening	3.83 ab	0.87 a	9.43 a	10.87 b	23.10 ab	70.73 b
Unwax degreening 1000 ppm	3.0 b	0.66 c	8.00 a	10.23 b	20.11 b	76.30 ab
Wax degreening 1000 ppm	3.67 ab	0.78 ab	9.10 a	13.8 a	29.61 ab	107.37 a
Unwax degreening 2000 ppm	3.0 b	0.71 bc	9.50 a	13.49 a	21.59 ab	68.64 b
Wax degreening 2000 ppm	3.0 b	0.65 c	9.12 a	13.96 a	33.06 a	80.78 ab

In Table 5 showed that the green colour of citrus fruit could be changed to yellow colour by ethrel, but percentage of juice to become decreasing. This table show that treatment of dip ethrel 1 000 ppm and waxing gave the best quality and it has yellow colour, 9.10 ^{o} Brix, ratio sugar and acid 13.79, juice 29.61 % and vitamin C 107.37 mg/100 ml sample.

The optimal ethylene concentration and treatment duration varies by cultivar and growing conditions. Fruit which develops under high night temperatures usually needs a higher concentration of ethylene to de-green the peel. However, ethylene concentration should never exceed 10 ppm. Higher ethylene concentrations do not speed up the rate of de- greening, but increase postharvest decay (Anonym, 2004).

For the next time, it is important to do the best practice treatment. It is caused the best treatment could produce superior fruit quality, the best performance of fruit and making fruit stored much longer.

Many activities in this project could be learned with understanding easily, such as method of meeting with farmer/trader, cultivation technical (prunning, thinning, and clipping), crop load,waxing and sanitation of fruit.

This project could benefit the farmer because the best practice could produce superior fruit quality, the best performance of fruit and making keprok stored much longer. The best quality could be sold with high price and obvious gave benefit of growers.

One activity still learn further such as fruit size management that consist of estimating crop load, predictive fruit size model and measuring vitamin C of fruit.

CONCLUSIONS

1. The best practice treatment has average fruitlets 2.5 – 4.5 in Bantaeng and 2.25-7.25 fruitlets in Jeneponto. Whereas the traditional practice has average fruitlets 1-8 in Bantaeng and 3-8.25 fruitles in Jeneponto. As a guide if the average fruit count is greater than about 8-10 fruitlets per frame for oranges or for imperial mandarins 8-10 fruitlets per frame, then thinning should be beneficial.
2. Weight fruit, brix and ratio brix and acid showed that the best practice treatment has better than the traditional treatment in Bantaeng and Jeneponto and significant different. The best practice treatment produce the best quality of fruit that have the highest weight fruit (179.0 g in Bantaeng and Jeneponto), brix (10.63^{o}Brix in Jeneponto and 9.8^{o}Brix in Bantaeng) and ratio brix and acid (12.15 in Jeneponto and 9.4 in Bantaeng).
3. Wax has interaction effect significantly with refregerated and variety treatment on vitamin C, weight loss and juice percentage. Besides, wax has interaction effect significantly with refregerated treatment only such on colour, size and acidity fruit. But brix and ratio brix and acid has not given significant effect all of treatments. The best quality as keprok Siompu wax refregerated with the highest of vitamin C (128.85 mg/100 g sample), juice (42.44%), green colour, size of fruit (66.5 mm) and the lowest weight loss (2.47%).
4. Sanitiser could press of sour rot development. whereas control as water only caused keprok be attacked by sour rot until 91.66% at 20 days. Sanitisers as soda ash 3%, sodium bicarbonate + sodium hipoclorite and fungiside as Dithane or both sanitiser and fungicide (Dithane + soda ash) could significantly improve the quality of fruit going to export market.
5. The green colour of citrus fruit could be changed to yellow colour by ethrel, but percentage of juice to become decreasing. Degreening with dip ethrel 1 000 ppm and waxing gave the best quality and it has yellow colour, 9.10 ^{o} Brix, ratio sugar and acid 13.79, juice 29.61 % and vitamin C 107.37 mg/100 ml sample.

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APPENDICES

1. Leaflets for the farmer

No.	Name of leaflets
1.	Teknologi budidaya jeruk keprok (Cultivation practice of keprok tecnology)
2.	Cara mengukur muatan buah per pohon yang ideal (Crop Forcasting)
3.	Perbaikan kualitas buah jeruk keprok melalui sanitasi buah, pelilinan dan degreening (Improving of citrus fruit keprok through fruit sanitizer, waxing and degreening)

2 Grower meeting and demonstration

Agenda	Informant (narasumber)	Date
1. Meeting with grower and extension to choice site of experiment	Wanti Dewayani	1 July 2009
2. Plotting in demoplot sites	Dr.Taufiq Ratule and Wanti Dewayani	6 July 2009
3. Training and demonstration cultivation	Adi Cahyono and Wanti Dewayani	6-7 January 2010
4. Making of california pulp to control diplodia disease and demonstration	Wanti Dewayani	February 2010
5. Evaluation demoplots	Dr. Hardiyanto and teams	1 July 2010

3. Result of citrus leafs analisys in Jeneponto and Bantaeng Regenscies

Parameters	result	
	Jeneponto	Bantaeng
N-total, %	2.37	2.73
P, %	0.27	0.14
K, %	0.44	0.73
S-total, %	0.05	0.05
Moisture, %	3.14	3.60
Ca, %	2.61	3.55
Mg, %	0.50	0.44
Zn, ppm	95.33	2.18

4. Leaf analysis standards for citrus

Element	Deficient range[a]	Low range	Satisfactory range	High range	Excess range
	As percentage of dry matter of leaf				
Nitrogen[b]	Below 2.20	2.20–2.39	2.40–2.69	2.70–3.00	Above 3.00
Phosphorus	Below 0.10	0.10–0.13	0.14–0.16	0.17–0.30	Above 0.30
Potassium	Below 0.40	0.40–0.69	0.70–1.30	1.31–2.00	Above 2.00
Calcium	Below 1.60	1.60–2.90	3.00–5.50	5.60–7.00	Above 7.00
Magnesium	Below 0.16	0.16–0.29	0.30–0.69	0.70–1.00	Above 1.00
Sodium			Below 0.16	0.16–0.25	Above 0.25
Chlorine			Below 0.30	0.30–0.60	Above 0.60
Sulphur	Below 0.14	0.14–0.19	0.20–0.39	0.40–0.50	Above 0.50

Source : Anonym (2011)

5. Result of demoplot soil in Jeneponto and Bantaeng Regencies

Sample code	texture			S total	pH (1: 2,5)		Organic material		C/N	Extract HCl 25%		Olsen/Brays	
	sand	debu	liat		H_2O	KCl	C (Carbon)	N (Nitrogen)		P_2O_5	K_2O	P_2O_5	K_2O
	%			%	%					mg/100gram		ppm	
2	3	4	5	6	7	8	9	10	11	12	13	14	15
Jeneponto	25	42	33		6,14	5,17	0,97	0,24	4	78	34	189	84
Bantaeng	14	50	36		5,68	4,77	1,95	0,49	4	122	37	87	193

Sample Code	EC		Extract KCl 1 N		Exchangable cation						
	DHL	acidity	Al-exchangable	H-exchangable	Exchangable cation					KTK	KB
					Ca	Mg	K	Na	Total	CEC	BS
	ms/cm				me/100 gram						%
2	3	4	5	6	7	8	9	10	11	12	13
Jeneponto		0.00	0.00	0.00	15.88	3.83	0.18	0.11	20.00	18.36	100
Bantaeng		0.00	0.00	0.00	17.64	5.88	0.41	0.001	23.91	31.19	77

Figure 11. Trying waxing of keprok Siompu in laboratory BPTP Makassar

Figure 12. Performance treatment keprok Siompu after stored 2 weeks

Figure 13. Pak Adi Cahyono training of growers and demonstrating of the best practice tree

Figure 15. Demonstration fertilizing of Best practice tree in demo plot, Jeneponto

Figure 16. Local dinas pertanian staff with grower trying fertilizing after demonstrated by Pak Adi Cahyono

Figure 17. Pak Arry discussing with growers and local dinas pertanian during plot visit

Figure 18. Pak Peter during demo plot visit in Bantaeng and Jeneponto, South Sulawesi

Figure 19. Assesment of various fungicide and salt concentration on the development of sour rot

Figure 20. Degreening and wax treatment on keprok Selayar

Figure 21. wax and unwax teratment unrefregerated storage on two weeks

Figure 22. wax and unwax teratment refregerated storage on two weeks

Greasy Spot
Mycosphaerella citri

Description
Symptoms first appear as yellow mottling on the lower leaf surface. Later hypha growth within leaf tissue causes cellular swelling resulting in blister formation on the lower leaf surface.

Effects
High levels of leaf infection can result in leaf drop and overtime reduced tree vigour. Fruit staining / rind blotch is infrequent.

Cultural management options
Removing or burying infected leaf litter (within 4 weeks of a significant leaf drop) will help lower disease inoculum.

Modifying tree architecture (skirting and thinning out upper branches) so that trees readily dry out after rain events will help to reduce frequency and severity of infection.

Cultural practices will not give adequate control in wet regions.

Chemical management options
Foliar sprays of Copper (Oxide / Oxychloride) is the primary method used for managing the disease.

Petroleum Summer Oil sprays at 1% could be considered as a substitute for copper if concerns existed over copper contamination in waterways. Summer oil is not directly fungicidal but reduces penetration by the fungus and delays development of symptoms.

Timing of applications
Infection and development of greasy spot is slow making timing relatively flexible. A single summer application of copper in mid January should provide adequate control in most areas.
Two applications could be needed in high disease orchards e.g. December and again in February or around one month after spring and summer growth flushes have matured.

Cautions
- Summer oil is likely to have an adverse effect on colour in tropical regions when used later in the season (after December in the Southern hemisphere)
- Summer oil should not be used on trees with poor health
- Summer oil should not be used if trees are under moisture or other environmental stress's
- Copper sprays can cause fruit blemishes if applied at low pH or under slow drying conditions.
- Copper can enhance or blacken existing scars caused by wind / insects particularly when used in a serial spray program or at heavy rates. (Copper Oxychloride and Hydroxide forms appear to be more of an issue in this regard than Oxide forms)
- Long term, repetitive copper sprays may lead to toxic soil accumulation
- Excess copper accumulation can be phytotoxic to citrus trees where soil pH drops below 6.5

Citrus Tree Training Notes

Introduction
The following notes are given as a general guide to the management of young citrus tree canopies.

Overview
The role of citrus pruning in young orchards is primarily to identify and preserve branches which will make good future scaffold limbs (those well orientated / angled) and to remove unwanted branches (those poorly orientated / angled) which will have an adverse affect on tree development and production.
The natural growth habit in citrus varies according to variety, tree age and vigour within the tree.

Citrus tree growth is regulated by apical dominance. That is terminal buds (buds at the tip of vertical shoots) produce an auxin which suppresses lower buds and the production of side shoots. Apical dominance is lost if this bud is removed or if the shoot falls or bends to a horizontal position.

It is common for citrus varieties to exhibit an upright growth habit where a few strong vertical shoots grow more vigorously than the rest of the canopy. These shoots if not removed by pruning dominate the tree structure producing columnar shaped trees.

Where branches are well orientated and balanced the natural growth habit of the tree should be allowed to develop without intervention.

The natural growth habit is where new shoots sprout and grows upwards from a falling or horizontal branch; over time these new shoots grow and fall under their own weight (loosing apical dominance) and the whole process is repeated. Some mandarin varieties may maintain a more upright branch structure.

Nursery Trees
Citrus trees are typically supplied from nurseries in two basic forms, whips and headed trees.

Whips
These are usually planted out one year after grafting and are unbranched trees with a single upright stem.

Desirable standards for a ‘whip’
- tree height 80cm or higher
- stem girth >8mm (one inch above graft union)
- Bud or Graft union 20cm above soil level

Headed trees
These trees are older trees usually planted out 18 months to 2 years after grafting. These trees have been headed to develop branches in the nursery.

Desirable standards
- height 80cm or higher
- stem girth >10mm (one inch above graft union)
- Bud or Graft union 20cm above soil level

Orchard Trees
Sourcing good quality citrus trees ‘is a must first step’ in developing a productive orchard.

Immature trees or trees with poor vigour will be difficult to establish and will be much slower to come into production. Where possible, trees should be viewed at the nursery prior to dispatch to ensure

they are up to an adequate standard. Poor quality trees should not be accepted or planted out.

If this is not an option (or if trees have already been planted) the focus during the first year needs to be on improving tree vigour and size

through careful water and nutrition management.

For undersize 'whips' training needs to ensure the central stem is supported and trained to an adequate height.

Characteristics of a good nursery tree

- vigorous
- healthy, large, dark green leaves
- straight trunk
- bark smooth textured & clean
- feeder roots well developed / straight tap root
- trees free from visible insect / disease

Training objectives

To develop a tree with a single trunk and 3-6 equally orientated limbs (future scaffolds).

To position limbs 50 to 85cm above ground level and 30cm above the graft union. (Limbs should be selected from different heights if originating from the trunk e.g. allow 5cm gap).

To have scaffold limbs developing at 45º from the vertical and horizontal plane (or at least 30° from the vertical or 30° from the horizontal).

Flat growing branches don't make good scaffolds as they are likely to droop, loose apical dominance and be replaced by an alternate branch with a better angle. Flatter branches while not suitable as a scaffold may develop into a good fruiting branch if not too low to the ground.

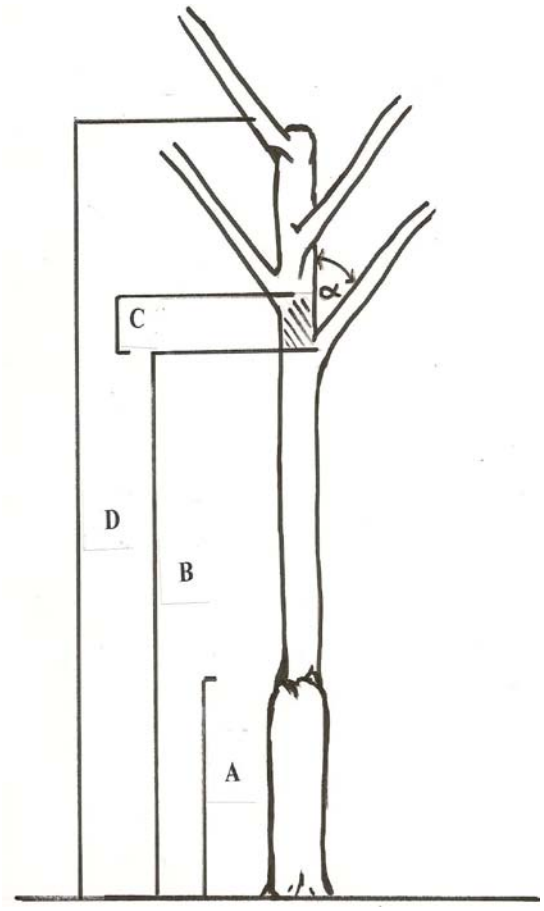
Very upright branches may grow stronger than other selected limbs and become a sucker that causes the tree to become unbalanced.

Challenges

The selection of ideal scaffold limbs with ideal branch angles is sound in theory but often difficult under field conditions as:

- branch selection is often limited (marginal or poor angles, uneven orientation)
- dominance can shift as branches extend and bend under their own weight
- Regrowth following pruning can be unpredictable

With this in mind growers should ignore irregularities or the lack of ideal branches and allow the tree to develop over time.



A (20cm)
B (50cm) **Angle** (45°)
C (5cm)
D (85cm)

Branch Characteristics

Branches which are angled at 45° (as shown above) provide the most robust and productive tree framework.

Vertical branches tend to be vegetative (non-fruiting) and quickly take over or dominate other potential scaffold limbs as shown. Vertical branches should be removed as early as possible.

Training (planting to one year)
'Whips'
Shorten whip to 80cm. This will force branching during the first year of growth.
Check for and remove shoot growth below 50cm. This should be followed up 3-6 months after planting.
Tree guards should limit unwanted shoots sprouting below the tree head.
Headed trees'
Select potential scaffolds; keep well orientated branches with a preference toward those with good angles. Thin out unwanted branches e.g. those growing below 50cm, those crossing over the tree centre and strong vertical growth if threatening to dominate tree structure.

It may be advantageous to shorten limbs (back to 15-20cm) at planting if branches are poorly defined or if tree heads are out of balanced with the root system
Pruning (one to six years)
Continue selecting / maintaining integrity of scaffold limbs (e.g. thin out competing scaffolds and sucker growth).
This is best done regularly (e.g. annually) as early removal of unwanted branches (before they reach 40cm in length) will deplete trees less than the removal of large limbs later in a trees development.
At any time remove no more than 10-20% of canopy volume, as stored branch reserves (carbohydrates) and leaves are the factory which will increase the size of the tree.
Manipulating vegetative growth
As trees develop, vegetative growth can be manipulated into a productive state to fill bare areas of scaffold. To achieve this vegetative growth is either cut back into mature rounded wood or bent

horizontally. Excessive regrowth (suckers) should be rubbed off while young.
Shaping scaffolds
Where the natural growth habit is upright (common within mandarin types) consider strategies which will encourage the development of more open angles e.g. allow crop weight to spread limbs (don't overcrop and risk breakage), or experiment with spreading / staking if labour and materials are available and the expense can be justified.
Pruning cuts
Cut cleanly at the point of origin if wanting to avoid or minimise the risk of regrowth following pruning (e.g. avoid leaving a stub).

Disease protection / Sanitation
Use a sterilisation solution of 3% sodium hypo chloride to clean pruning equipment to avoid spreading disease.

Don't contaminate pruning cuts with soil due to dirty pruning equipment / climbing etc).

Prune during the 'dry season' in tropical regions, avoiding freshly made cuts from becoming wet.

Market Development for Citrus from Eastern Indonesia

ACIAR SMAR/2007/196

Travel Report for March & May/June 2009 visits

By Peter Taverner & Mike Rettke July 2009

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INTRODUCTION

The Australian Centre for International Agriculture Research (ACIAR) is managing a major program called the Smallholder Agribusiness Initiative (SADI) under the Australia Indonesia Partnership. The goal of SADI is to increase rural growth and household income through improved farmer productivity, better access to markets and on and off farm value added activities.

SADI consists of three subprograms. Subprogram three "Support for Market-Driven Adaptive Research (SMAR)" aims to improve access for farmers and agribusinesses SMEs to new knowledge supporting the production and marketing of agricultural outputs at higher levels of productivity and quality. The outcome is to improve the capacity of eastern Indonesia R&D providers to support market driven adaptive research.

Scoping studies identified a highly competitive citrus market with an opportunity to improve supply chain management and market penetration on products with comparative advantage, particularly keprok (mandarins) from regionally specific locations.

Due to the comparative advantage of Keprok from SoE, a project was proposed to focus on the development of a supply chain model from SoE in NTT, which will then be used as a tool for other provinces in Eastern Indonesia. The general aim is to improve grower returns through the adoption of improved production and post handling techniques and by increasing the understanding of and cooperation among the different segments of the citrus supply chain.

The specific objective of the project is to use keprok as a model for developing awareness of 'quality' parameters, product differentiation, emphasis the importance of appropriate post harvest handling and to introduce and foster market driven business practices in the keprok supply chain, forging stronger links between farmers and the marketplace.

This report provides notes/comments of the activities during two recent visits in March 2009 and June/July 2009. The March visit included field visits to SoE in NTT, Buton Island in South-eastern Sulawesi, and a progress workshop was held in Makassar in Southern Sulawesi. The May/June visit included harvesting and quality assessments on keprok SoE in NTT, and a wax fruit trial, with fruit send to a local Ramayama supermarket in Kupang, in gift boxes to Bali, and shipped by refrigerated vessel to Surabaya.

NOTES/COMMENTS

WEST TIMOR (KUPANG & SOE, 16-18TH MARCH)

Keprok orchards, Ajuabaki.

Travel from Kupang to Ajaobaki

Meeting at grower house introducing clipping of fruit to reduce damage and weight loss. Demonstration of fruit clipping and fruit sizing in orchard at grower's property. Cranston gauge presented and demonstrated to local Dinas Pertanian Officer (Pak John).

An orchard walk to discus issues and view problems on trees proved useful. Many keprok trees appeared to be suffering from 'Greasy Spot', especially young trees. Craig Swanburry from Fruit Doctors provided advice on disease management of small trees.

Meeting held at local hall to discuss the outcomes of the project and local issues. The emphasis was for growers to work through issues with the local Dinas Pertanian and BPTP officers. There was a grower expectation that we would provide materials, such as fertilisers and chemicals, to help in citrus production. We indicated to them that this was not the focus of this work. There may be some scope to provide materials, such as clippers for harvesting, but the major transfer is knowledge; specifically to improve quality through the local BPTP and Dina Pertanian officers.

Supermarket & Meratus Shipping, Kupang

Visit to Kupang supermarket "Ramayana". The main aim of the visit was to determine any traders to contact for later trial work, and discuss collaboration with Ramayana.

Ferdinand Romer ('Aver") is a relative newcomer, but is the current supplier of keprok SoE to the local Ramayana supermarket. Ferdinand buys fruit from SoE growers in the Kupang wet markets and sorts for size and quality. The selected fruit is sent to Ramayana and the rejected fruit is returned to the wet market for local trade.

Ramayama imports fruit into Kupang by refrigerated container, usually 25-30 tonnes per week. It was unclear what happens on the return voyage, but we should be able to find out from the shipping company, Meratis. Ramayama was interested in cooperating with a fruit trial.

A follow-up visit to Meratus yielded useful information. Vessels sail regularly from Surabaya to Kupang (6-7 ships per month). The voyage was about 3 days and most vessels caried about 80 containers; a mixture of refrigerated and dry cargo. The major refrigerated import was frozen chicken nuggets (fast food) and frozen fish was sent on the return voyage.

On average, 75 containers per year were shipped from Surabaya to Kupang and 200 containers per year were shipped from Kupang to Surabaya. Many more empty containers were shipped into Kupang, which increased shipping costs.

The shipping cost for a refrigerated container was 17-18M rupiah (AUD $2,000). The project does not have the volume of fruit to use a container for trials. However, the meeting established a potential refrigerated supply chain to East Java when volumes and quality can be supplied

consistantly.

The use of dry containers (at 4M rupiah per container) was investigated but, volumes are still an issue. Eventually, we were able to negotiate the use of a the ship's galley refrigeration for small consignments of fruit. This established a pathway for sending a fruit trial shipment. The next step was to contact a trader.

Trader visit, Kupang

We met Ferdinand Romer at the local wet market and went to his nearby house. Ferdinand collects keprok SoE from the market and sorts to Ramayama's standards. Generally, 25% of the fruit is A grade for Ramayama. He pays the collector for the A grade fruit and returns the remaining 75%. The A grade fruit is packed in plastic crates from Ramayama and delivered to Ramayana in the neighbours truck. Ferdinand indicated strong interest in collaborating in a waxed fruit trial.

SOUTH EAST SULAWESI (BUTON ISLAND, 20-22ND MARCH)

Bau Bau city and Wabula

Visit to Dinas Pertanian Offices, Bau Bau city. They confirmed the recent new planting of keprok and provided data sheets on the production and tree numbers. The data sheets indicated that the Wabula and Sampolawa subdistricts were areas on Buton Island where significant new planting had occurred. We had previously visited the Wabula subdistrict, which currently had low production (588 mature bearing trees) but there have been massive plantings in the area, with almost 30,000 new siompu seedlings planted in recent years.

We visited Wabula and demonstration plots established by Dr. Taufiq Ratule, BTPT, where some thinning of fruit had been conducted. During the first visit, the growers indicated a strong tend towards biannual bearing of fruit on trees. It is expected that thinning and certain pruning techniques should even crop load over subsequent seasons. Craig Swanburry of Fruit Doctors, demonstrated the theory of pruning to induce more fruiting wood on younger trees during the visit.

A Grower meeting was held at Wabula. The growers were interested in more information about pruning and thinning. They currently harvest by colour (at about 50% colour break) and sell to collectors for Bau Bau city during the 3-month harvest (June-August).

SOUTH SULAWESI (MAKASSAR, 23-24TH MARCH)

Project workshop, BTPT Offices in Makassar

Project workshop held in BTPT offices in Makassar involved all regional team members. Initial presentations by Peter Taverner, Craig Swanburry and Andrew Green also included other BTPT staff. Peter Taverner outlined the completed and intended activities for the duration of the citrus project, and postharvest techniques to improve keprok marketing. Craig Swanburry described the role of Fruit Doctors in servicing the Australian citrus industry and techniques to accurately measure fruit size and crop density. Finally, Andrew Green outlined the marketing system for Australian citrus and the role of crop estimates in orderly marketing.

After lunch, a smaller meeting with team members discuss the project activities (see appendices 4 & 5). Significant discussion took place regarding the possibility of a wax fruit trial later in the season. It was agreed that the trial should occur in May to coincide with the peak keprok season and the shipping program.

WEST TIMOR (KUPANG, 27TH MAY-1ST JUNE)

Evening meeting (27th may) was held with the team, Mr. Agus (Ramayama) and Mr. Romer (trader) to discuss the logistics of the wax trial and collection of fruit.

Pak Didiek and Ady arrived in the morning (28th May) with 150kg of good quality fruit for fruit waxing trial. Additional fruit from 12 trees from the demonstration plot were unloaded and stored at BTPT laboratories for later quality assessments.

The team travelled to Ferdinand Romer's house and unloaded fruit and waxing materials. Keprok was sorted to Ramayana specifications. Returned to Ramayana supermarket to check cool room space and discuss trial with store manager.

Return to Ferdinand's house to conduct fruit waxing. The procedure was explained to Ferdinand and team members waxed ~30% of the keprok, which was air-dried on wire mesh. Dried fruit was packed into 3 plastic table grape crates (8 kg net), and a further 3 crates were packed with unwaxed fruit. This fruit was intended shipping to Surabaya later in the week. Phillip Morey packed 4 gift packs (2.5kg net per pack) with waxed fruit for distributors/suppliers of imported fruits in Bali. The remaining waxed fruit (~30kg) and unwaxed fruit (~60kg) was packed normally for transfer to the local Ramayana supermarket.

Fruit transported to Ramayana supermarket and quality check before acceptance culled a small amount of fruit (~2kg). Some fruit was placed in the cool room and other fruit was left unrefrigerated for later weight and quality comparison.

Waxed and unwaxed fruit was displayed along side each other in the Ramayana supermarket. All keprok SoE was labelled with the same price. Surveys of shoppers were undertaken to determine preference and the relative sales monitored. Activities conducted by Liz Gunner, Karen Shephard, Boga Kuntoro and Phillip Morey.

The remaining team members conducted quality assessment on fruit from the demonstration plot near SoE. The fruit were analysed using similar techniques to previous seasons. One interesting observation was that the fruit from fertilised/irrigated trees and control trees were similar at harvest, but fruit from fertilised/irrigated trees coloured and ripened much quicker after harvest.

Unfortunately, the vessel to Surabaya was delayed and the wax fruit had to remain in cool store in Kupang for over a week. A meeting was held to develop detailed procedures and the roles for the team members in Kupang and Surabaya. The meeting also discussed future activities in West Timor and Sulawesi.

The consignment of waxed keprok was eventually transferred to the vessel by Pak Bambang and collected by Pak Boga in Surabaya. Pak Boga transported the fruit to supermarkets in Ramayama, photographed fruit and assessed weight loss (separate report by Boga; available on request).

ANALYSIS AND REFLECTION

MARCH 2009

The visit to West Timor was productive. The fruit clippers and fruit sizing created great interest. Craig Swanburry, of Fruit Doctors, is also a citrus grower in Australia. He had good discussions with local growers and added to the visit. The introduction of invited 'specialists' to the growers' visits has been successful and should be continued.

In regard to fruit sizing training, the Indonesian partners were very adept at learning new skills during the 'quality' assessments. We will reinforce these techniques during the visit to Australia in October.

It also provided an insight into the maturity of fruit to program a fruit trial later in the season. After the visit to growers, we returned to Kupang to discuss a potential trial with the local Ramayana supermarket, a shipping company and a local trader associated with Ramayana. The discussions were useful and all the people were open to collaborate with a fruit trial. A previous visit established that it would be very useful to track a trial shipment of keprok SoE from harvest through to sales in Surabaya. Given the thin skin of the keprok SoE, the use of a commercial wax on the fruit would provide the highest protection from water loss, and, should significantly improve shelf life. A trial shipment, which includes some waxed fruit, would allow a comparison of quality during normal transit and provide a demonstration to the supermarkets. The logistics of conducting this type of trial was scheduled for discussion in the Makassar workshop .

The visit to Buton Island built on the previous visit. Last visit indicated a strong pattern of biannual bearing and Craig Swanburry was brought back this visit to see the trees and formulate strategies (ie, puning techniques) to reduce the strong on/off bearing. Dr. Ratule also showed us demonstration pots established to assess the effects of fruit thinning on mature trees. Unfortunately, many of these mature trees were diseased, which may confound the results. It would be better to conduct demonstrations on younger healthy tree when they begin bearing more fruit.

The workshop in Makassar was also very productive. The presentations reinforced the aims of the project to improve quality and marketing through better information. Team members discussed the possibility of a wax trial and it was decided to conduct it in late May. The trials were to consist of sending waxed and unwaxed fruit to Surabaya by a Meratis vessel. There will also be waxed and unwaxed fruit sent into the local Ramayana supermarket for sale. Considerable coordination would be necessary for trial shipment to be successful and Mr. Phillip Morey was asked to collaborate with participants in West Timor. Visual assessment and weight loss would be used to compare the quality of waxed and unwaxed fruit after the voyage. Liz Gunner and Karen Shepherd would be asked to collaborate with Pak Boga to develop market surveys to assess fruit acceptance by consumers.

MAY/JUNE

The wax trial presented a number of logistical challenges that were met reasonably successfully. The involvement of Phillip Morey was critical in maintaining the line of communication and 'problem-solving' issues in Indonesia before the rest of the team arrived. Pak Didiek and Ady did a very good job to source good quality fruit and deliver it on time. The fruit from the demonstration plot and the wax trial fruit had to be kept separately and stored under different conditions, and this was well managed by Didiek.

On the first evening it was important to have discussions with the trader (Ferdinand) and Ramayana (Mr. Agus) to ensure that they were both aware and comfortable with arrangement for the trial.

Sorting and waxing of fruit at Ferdinand's house was very successful. The team members were involved in the waxing procedure and learnt new skills. Ferdinand was impressed with the appearance of the waxed fruit and indicated that he would like to continue to use the wax provided it was safe for him and consumers. We tried to ally any concerns of Ferdinand and left a large quantity of wax for him to use for the remainder of the season. It will be important to see whether Ferdinand has continued to use the wax on keprok supplied to Ramanyana. Phillip Morey could be used to follow up to find this out.

The cost of the wax adds about 100 Rph per kg to the cost of the fruit, which is quite small compared to the ~30,000 RpH per kg paid to the trader by Ramayana. However, it will depend on the perceived advantages in appearance and storage life. The major cost was the shipping cost from Australia. This cost would by reduce further if wax was shipped in bulk or a domestic supplier could be found.

The marketing survey was well designed by Liz Gunner and Karen Shepherd. The survey in Ramayana indicated that the wax fruit was preferable to unwaxed fruit. A significant proportion was sold during the first day. Larger volumes of fruit would be required to determine whether the waxed fruit had a longer storage life under shop conditions.

The timing of the Surabaya trial was disrupted due to vessel delays, with fruit held for an extra week before departure. This placed greater strain on the fruit, but negotiation with Ramayana meant that some of the fruit could be stored in their cool rooms. The assessment at Surabaya indicated that the waxed fruit was superior in appearance. It also indicated that the refrigerated fruit tasted better. There were significantly lower decay rates in refrigerated fruit (3%) compared with unrefrigerated fruit (23%). Generally, the supermarkets were pleased with the taste and condition of fruit that was both waxed and refrigerated.

The success of this trial was due to the coordination of Pak Bambang in Kupang and Pak Boga in Surabaya. In particular, Boga assessed the fruit after the voyage and sent samples to various Surabaya supermarkets for appraisal.

The trial indicated that there is a refrigerated supply chain for keprok into Java. The supermarkets in Surabaya would accept produce in similar condition to the fruit in this trial. This is encouraging and suggests that inter-island trade is feasible. However, the market specifications met in this consignment need to meet for larger volumes and with a consistency of supply for profitable commercial trade to be sustained.

Currently, the supply of keprok meets local demand, and the grower, trader and local retailer receive good prices. The imperative for change will occur when the supply increases when recently planted citrus bears fruit. At that stage, the price will collapse unless new markets are opened, such as inter-island trading. Inter-island trading is likely to result in lower margins for growers than the current local premium because the keprok must match import fruit price and quality specifications. However, overall revenue will be higher. The challenge is to prepare the supply chain partners for the transition to inter-island trade and competition for imported citrus.

This model has proved successful and it would be useful to emulate in the other keprok regions to determine the potential supply chains for keprok. During the team meeting on the last day, it was decide that Boga would travel to Bau Bau city on Buton Island and then on to

Makassar to conduct market surveys. This information and further market related visits would be useful to develop similar trials in these areas.

APPENDIX 1 - Schedule

March 2009 Itinerary

During this visit, Craig Swanburry, a consultant from Fruit Doctors, will join the Australian team to demonstrate crop monitoring and crop sizing techniques. The team members will visit sites in NTT and Buton Island, then travel to Makassar for a workshop to discuss the project progress and future work. This workshop will introduce the New ICSRF Director to the team members and the activities of the program.

Sunday, Mar 15th

Travel to Denpassar

Team Members involved: Peter Taverner, Andrew Green and Craig Swanburry.

Monday, Mar 16th

Travel to Kupang

Team Members involved: Peter Taverner, Andrew Green and Craig Swanburry.

Tuesday & Wednesday, Mar 17th & 18th

Activities:

- Visit field sites in Ajaubaki and Tobu, start crop estimate and fruit sizing trials; Discuss thinning and pruning with local growers;
- Visit local trader to discuss wax trial shipment in July.

Team Members involved: Peter Taverner, Andrew Green and Craig Swanburry. NTT staff, .Ary Supriyanto, Taufiq Ratule and Wanti Dewayani.

Thursday, Mar 19th

Travel to Makassar

Team Members involved: Peter Taverner, Andrew Green and Craig Swanburry; Bambang Murdolelono, .Ary Supriyanto, Taufiq Ratule and Wanti Dewayani.

Friday, Mar 20th

Travel to Bau Bau City, Buton Island

Visit local BTPT/Dinas Pertanian

Team Members involved: Peter Taverner, Andrew Green and Craig Swanburry; Bambang Murdolelono, .Ary Supriyanto, Taufiq Ratule and Wanti Dewayani.

Saturday, Mar21st

Activities:

- Visit keprok growers to visit sites and compared thinned and non-thinned trees. Trial organised by Pak Taufiq. Discuss issues and demonstrate crop thinning and pruning with growers.

Team Members involved: Peter Taverner, Andrew Green and Craig Swanburry; Bambang Murdolelono, .Ary Supriyanto, Taufiq Ratule and Wanti Dewayani.

Sunday, Mar 22nd

Travel to Makassar

Team Members involved: Peter Taverner, Andrew Green and Craig Swanburry; Bambang Murdolelono, .Ary Supriyanto, Taufiq Ratule and Wanti Dewayani.

Monday, Mar 23rd

Project Workshop in Makassar

Activities:

1. Presentation on citrus postharvest handling (Peter)
2. Presentation on citrus marketing (Andrew)
3. Presentation on citrus integrated pest management (Craig)
4. Discussion on project progress and next steps (Peter and Ary)
    a. Keprok trial of waxed fruit from NTT to Surabaya or Bali,
    b. Selayar visit, and
    c. "Quality Citrus" extension material for growers.

Team Members involved: Peter Taverner, Andrew Green and Craig Swanburry Phillip Morey; Bambang Murdolelono, .Ary Supriyanto, Taufiq Ratule, Wanti Dewayani and the New ICSRF Director.

Tuesday, Mar 24th

Visit to ACIAR Offices in Makassar.

Depart to Denpassar, then to Australia (arrive Wednesday, Mar 25th)

Team Members involved: Peter Taverner, Andrew Green and Craig Swanburry;

May/June 2009 Itinerary

During this visit, there will be several activities occurring at different places and times. Project members will form smaller teams to conduct part of some activities. Ms. Liz Gunner and Karen Shepherd will be conducting market analysis, with Pak Boga. Mr. Mike Rettke, is a senior postharvest scientist and, with Peter Taverner, will conduct fruit waxing and quality assessment with the remaining team members. Mr. Phillip Morey will also support and assist in the activities. The major activities in chronological order (kesibukan susunan menurat urutan waktu) are:

Keprok collection

Fruit waxing at traders home

Transporting the fruit to Kupang supermarket and Meratus vessel.

Market assessment of keprok in Kupang supermarket (while vessel travelling to Surabaya)

Quality assessment of keprok from demonstration plots (while vessel travelling to Surabaya)

Travel to Surabaya to inspect and weigh keprok after voyage (Indonesian team only)

Market assessment of keprok in Surabaya supermarket

Liz and Karen will take waxed fruit to retail outlets in Denpassar (while vessel travelling to Surabaya)

Tuesday, May 26th

Activities:

Travel to SoE and prepare for collection of keprok

Team Members involved: Pak Anto Hardiyanto, Didiek, and Adi

Travel to Denpassar

Team Members involved: Peter Taverner and Mike Rettke.

Wednesday, May 27th

Activities (Keprok collection)

Collect 50 fruit per tree (10 trees) from Osias Kefi's property

Collect 100Kg big size keprok from other demonstration plot trees.

Return to Kupang. The keprok should be refrigerated overnight in Kupang.

Team Members involved: Pak Anto, Didiek, Adi and John

Travel to Kupang

Team Members involved: Peter and Mike.

Accommodation: Kristal Hotel, Kupang

Meeting to discuss waxing trial and evening meal with local trader (Ferdinand) and supermarket manager (Mr. Agus) (Phillip Morey and Didiek to arrange).

Team Members involved: All team members

Thursday, May 28th

Activities (Keprok into Surabaya supermarket):

Ensure the 50 fruit per tree are refrigerated until required (Saturday).

Transport big size keprok to trader, sort to trader's quality specifications.

Arrange suitable packaging (with trader or supermarket)

Organise waxing equipment and drying racks

Wax keprok allow to dry, then weigh

Transport the keprok to supermarket cool room.

Keprok remains in supermarket until loaded onto Meratus vessel.

Team Members involved: all team members

Friday, May 29th

Activities (Keprok into Kupang supermarket):

Use trader's keprok or get keprok from local wet market and sort to trader's quality specifications.

Arrange suitable packaging (with trader or supermarket)

Wax keprok allow to dry, then weigh

Transport the keprok to supermarket cool room.

Team Members involved: all team members

Saturday, Mar 30th

Activities (Load vessel):

Transport keprok to Meratus vessel

Ensure keprok is appropriately stored in cool storage or at ambient temperature.

Team Members involved: all team members

Activities (Quality assessment of Osias Kefi's keprok)

Transport fruit from refrigeration to BTPT offices for analysis

Conduct quality measurements (fruit size, brix:acid, juice content and colour) on all samples (10 trees).

Team Members involved: Peter Taverner, and Mike Rettke; Anto Hardiyanto, Adi Cahyono, Bambang Murdolelono, Ary Supriyanto, Taufiq Ratule and Wanti Dewayani.

Activities (Market analysis in Kupang supermarket)

Monitor the sale of waxed keprok

Conduct consumer surveys

Team Members involved: Liz Gunner, Karen Shepherd, Phillip Morey and Kuntoro Boga.

Sunday, Mar31st

Activities (Quality assessment of Osias Kefi's keprok)

Complete the quality measurements (fruit size, brix:acid, juice content and colour) on all samples (10 trees).

Team Members involved: Peter Taverner, and Mike Rettke;

Activities (Market analysis in Kupang supermarket)

Monitor the sale of waxed keprok

Conduct consumer surveys

Team Members involved: Liz Gunner, Karen Shepherd, Phillip Morey and Kuntoro Boga.

Monday, Jun 1st

Activities (Meeting & travel):

Meeting to exchange results and final discussion on the requirements for the Surabaya keprok assessment before teams separate to travel to Denpassar or Surabaya.

Team Members involved: All team members

Travel to Surabaya

Team Members involved: Anto Hardiyanto, Adi Cahyono, Kuntoro Boga, Ary Supriyanto, Taufiq Ratule and Wanti Dewayani.

Travel to Denpassar

Team Members involved: Peter Taverner and Mike Rettke (Liz Gunner, Karen Shepherd and Phillip Morey may travel to Denpassar on Sunday).

Return to Australia (Peter & Mike only)

Tuesday Jun 2nd

Activities (Keprok into Surabaya supermarket)

Meet the Meratus vessel in Surabaya and transport keprok to Ramayama supermarket in Surabaya

Weigh keprok (same procedure as in Kupang) and visual inspection with Ramayama staff

Monitor sales of keprok

Consumer surveys (coordinated by Phillip Morey)

Team Members involved: Anto Hardiyanto, Adi Cahyono, Kuntoro Boga, Ary Supriyanto, Taufiq Ratule and Wanti Dewayani .

Wednesday, Jun 3th

Activities (Keprok into Surabaya supermarket)

Complete consumer surveys if necessary.

Team Members involved: Kuntoro Boga and Phillip Morey.

All team members return home.

APPENDIX 2 – KEY CONTACTS

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Kupang NTT, 16-17 March 2009

Phillip Morey
Morelink

Ramayana – Agus, Fruit Marketing Manager
Brings 5 reefer containers (TEUs) per month from Ramayana Surabaya direct to Kupang
Container has mostly imported fruits (80%), local Indonesian fruits (10%) and local vegetables (10%). Also, small volumes of dairy and other refrigerated food items. Also, brings in some frozen foods including french fries, chicken nuggets, etc
20% of imported fruits are sold direct by the carton to other retailers; Ramayana Kupang operates as a distributor for imported fruits.
Sells about 25 tonnes of fruit per month
Ramayana has a small coolstore where imported fruits are stored.
Keprok SOE season (April – July) does not compete with imported Chinese manadrins
Agus is willing to display and sell waxed keprok but at the same price; too difficult from administration to add another product code for any additional fruit

Big Collector / fruit trader – Ferdinand Romer
Ferdinand is one of 10 big fruit collectors based in Kupang
The small collectors who live in the farming community (eg Soe) buy the produce from the farmer and bring to Kupang to sell to markets and big collectors
Only 25% of keprok from small collector is suitable for Ramayana; the remainder is given back to the small collector who sells to the wet market; Criteria for keprok is based on size, red colour and smooth skin
Ferdinand is the exclusive supplier of fruits to Ramayana – local and inter island traded fruit
He has excellent book keeping records of sales by date, product type and payment
Visited his house where on the front verandah he does the sorting and packing; location was suitable for a waxing trial
He meets the small collector at the pasar and brings the fruit to his house (3 kms away) by motor bike; one container (40 kg) at a time. He usually brings 5 containers.
The product for Ramayana is taken by small pick up truck (rental from neighbour) from his house to Ramayana store.
Ferdinand is willing to participate in the trial of waxed keprok to Ramayana

Meratus Line (Shipping Company) – Yongky Suherman (owner representative)
Surabaya to Kupang is 3 days by sea; 6 to 7 ships per month; small ships of 80 teus
Meratus is the only shipping company in Kupang that has reefer containers
Trade is about 200 reefer containers per year with about 70 full containers from Surabaya to Kupang and 200 full containers from Kupang to Surabaya. Therefore, 130 reefer containers sent from Surabaya to Kupang are empty at a cost of about Rp 5 million each per voyage.
The full containers cost about Rp 17 – 18 million each or Rp A$0.25 per kg based on maximum loads of 12 tonnes (containers have a net tare of 21 tonnes)
Kupang to Surabaya is mainly frozen fish (tuna)
Surabaya to Kupang is fresh fruit produce (5^0 C) for Ramayana or frozen chicken and chips for KFC.
Yongky has agreed that we can use the ships cool room to send a trial of say 5 cartons of keprok from Kupang to Surabaya.

Project Management

Market development for citrus from Eastern Indonesia

SMAR/2007/196

Activities

- Australian staff viewed local practices of harvesting, sorting and handling techniques for keprok in all regions
- In NTT, established demonstration plots (eg. different watering/fertiliser plots), and manage subsequent seasons.
- Obtained equipment for quality work (brix refractometers and burettes for acid titration)
- Develop methods to evaluate 'market quality' in the demonstration plots – establish 'before' values for demonstration plots in first season.

Sep 2008

South Australia

Activities

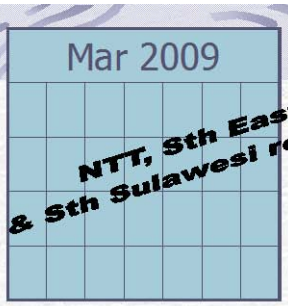
- Indonesian staff will be placed in with crop monitors to learn 'hands-on' the techniques for crop forecasting and sizing,
- Visit to regional citrus marketing boards to discuss use of crop forecasting information,
- Visit to private insectary and crop monitor service to discuss damage thresholds and beneficial insects,
- Visit to conventional and organic citrus growers properties.

Sep 2008

South Australia

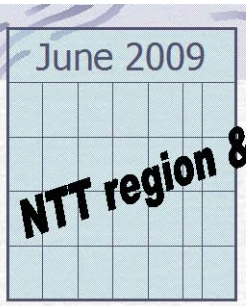
Activities (continued)

- Postharvest training commenced at South Australian Research & Development Institute (SARDI) laboratories.
- Introduced maturity testing methods using brix:acid ratios.
- Introduced simple waxing techniques on mandarins
- Introduced weight loss measurements as indicators quality loss (compare waxed vs unwaxed fruit; compare cool storage vs ambient).



Activities

- Use established demonstration plots to demonstrate newly acquired crop forecasting and sizing techniques.
- Assist and help establish a sampling regime for crop forecasting/crop sizing and maturity testing (eg. Brix:acid ratio).
- Introduce fruit thinning, pruning and clipping of fruit (Buton Island)
- Project team workshop in Makassar



Tentative Activities

- *NTT Activities*:
  - Collect fruit in SoE and transport to Kupang (Dideik, Adi & John)
  - Coordinate with trader to wax fruit and send to Kupang Ramayana.
  - Coordinate with trader to send keprok shipment to Surabaya retailer (include waxed fruit) (Phillip, Liz & Karen; Boga).
  - Assist with 'quality' trials e.g., collect fruit from demonstration plots and compare size and maturity and colour (Bambang, Taufiq & Wanti; Peter& Arry).
- *Surabaya Activities*:
  - Assess keprok in Kupang Ramayana and on arrival at Surabaya retailer. Monitor/assess consumer response (Phillip, Liz & Karen; Boga).


Oct 2009
South Australia
Tentative Activities
Indonesian staff will travel to the Riverland citrus region to visit commercial citrus packingsheds, demonstrate simple pruning skills (Fruit Doctors) and citrus orchards/varieties.
Visits to wholesale produce markets, central produce markets and supermarkets, visits to citrus marketing board to discussing marketing of citrus.


Oct 2009
South Australia
Tentative Activities
Mandarin storage trials at South Australian Research & Development Institute (SARDI), and used as 'hand-on' training of postharvest methods for staff.
Staff will be instructed in methods to evaluate decay control chemicals and general hygiene.
Introduce degreening using ethylene (ethrel dips)
Use fruit in storage trials to teach basic disease and disorder diagnosis of citrus.
Practical workshops will be held in the types of sanitisers, measuring and monitoring of sanitisers, and compatibility issues.
Citrus marketing workshop (Liz and Karen).

Tentative Activities

- *NTT Activities*:
  - Reinforce and refine principle established in previous seasons. Assist with 'quality' trials e.g., collect fruit from demonstration plots and compare size and maturity and colour. Compare results of forecasting and maturity over seasons.
- *Sth Sulawesi Activities*:
  - Commence gentle harvesting and clipping of fruit. Store fruit and assess condition and decay rates (compare clipped vs hand picked?).

Project Review

Supply chain activities

- Coordinate keprok shipment to Surabaya
- Include some waxed keprok
- Follow keprok to Surabaya supermarket
- Assess keprok in store

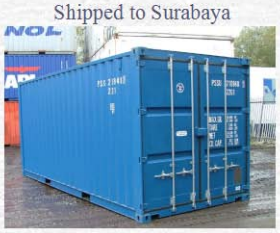
Harvest Keprok

Transport to Kupang

Sort and grade keprok

Surabaya Supermarket

Shipped to Surabaya



Pack into crates