

**PROCINORTE
FRUIT TREES TASK FORCE
Report to Board of Directors February 26, 2015
Costa Rica**

Progress Report:

The mission of the Fruit Trees Taskforce (FTT) is to develop solutions through agricultural research for improved production, quality and safety of fruits and to facilitate the exchange of scientific experiences, information and training by building linkages among public and private country institutions in the North American region.

The taskforce research is very relevant for advancing fruit production, post-harvest and processing and for providing scientific support for relevant quality regulation in the three countries. The three countries are investing a considerable amount of in-kind funding in this research, while funding from PROCINORTE is utilized for attendance of researchers to planning meetings and scientific meetings where results are presented. This taskforce carries out research, educational and outreach activities that demonstrate its contribution to solving problems affecting the fruit industry in the three countries, especially issues related to quality that have implications for trilateral trade.

The FTT Action Plan for 2014 included the following activities:

Activity	Excepted result	Budget
Evaluating avocado maturity using near-infrared.	Correlate NIR with dry matter and other parameters.	\$4,900 (estimated)
Prepare and submit proposal to BoD to develop NiR instrument to assess avocado maturity in situ.	Assist growers and packers to assess avocado maturity in an efficient and accurate manner.	To be determined
Improve and update the taskforce web site.	Disseminate Taskforce accomplishments.	
Taskforce meeting.	Discuss current research results; Meet new member from Canada; Visit orchards and packinghouses; prepare Action Plan 2015.	\$10,100
Total		15,000
Actually Spent		\$10,100

In February 2014, Taskforce members received the good news that the Board of Directors named Dr. Peter Toivonen as the new Canadian representative to the Fruit Trees Taskforce filling a void since 2012. At about this time, the Board of Directors also changed the name of the Taskforce from “Tropical and Subtropical Fruits Task Force” to “Fruit Trees Task Force.”

Accomplishments 2014

For the first time since 2010, the Taskforce was able to meet as a group in Ciudad Guzman, Mexico during October 13-16, 2014.

The objectives of this meeting were to:

1. Visit avocado orchards and packinghouse to plan development of technology to determine avocado fruit maturity through non-destructive methods.
2. Visit orchards planted to 'Mendez' and 'Hass' avocado with fruit on various stages of maturity.
3. Observe field sampling procedure for fruit picking and subsequent dry matter determination in packinghouse.
4. Study criteria used by harvesters to select fruit to be harvested in the orchard.

During the visit, Taskforce members visited various avocado orchards and packinghouses. Results from this trip were as follows:

1. Trip was a very productive one and Dr. Toivonen had a chance to learn about the challenges in correlating NiR with dry matter in avocado and to adapt and validate non-destructive data collected for the determination of dry matter in avocado.
2. There was valuable exchange of ideas among researchers and industry personnel concerning the need to develop a tool to determine dry matter non-destructively either in the field or in the packing line as a way to improve avocado quality.
3. Orchard and packinghouse owners, Mr. Ignacio González and Mr. Elias González showed their willingness to support this project, not only in economic terms by offering in-kind help for their employees' time but also on logistics, use of orchards, and packinghouse to make this project a success.
4. During the Taskforce annual meeting, research results were discussed, remaining activities on the 2014 Action Plan were discussed and re-evaluated, and the 2015 Action Plan was prepared. It was agreed by all members of the Taskforce that about \$5,000 remaining from the 2014 budget should be transferred to INIFAP (if approved by Executive Director) for training of an INIFAP scientist and/or Technician to understand how dry matter (DM) varies in various sections of an avocado fruit in order to make correct NiR measurements with the NiR prototype instrument that has been developed by the Taskforce. This project could not be carried out because IICA funds can't be transferred to another institution.

Since Dr. Peter Toivonen came on board Taskforce members decided to investigate further the potential of spectral reflectance to determine (predict) dry matter content of avocado fruits. To this end, Dr. Jorge Osuna performed in Mexico a series of fruit measurements with a spectrometer on various sections of avocado fruits to determine which section was more apt to determine avocado maturity and hence, fruit quality. This instrument measures reflectance between 350 and 1050 nm and is reliable, user-friendly, and relatively affordable. Moreover, its small size makes it an excellent choice for a portable instrument.

Some results of this preliminary work were summarized as follows by Dr. Peter Toivonen upon analyzing the data:

**Summary of data analysis from second set of avocados sent by Dr. Jorge A. Osuna-García.
Peter M.A. Toivonen, AAFC, Summerland, British Columbia, Canada**

The data from dorsal and ventral portions measured at the equatorial and neck tissues was analyzed separately and in combined format. The spectral data for each sample was evaluated for quality assurance purposes since it became apparent that many samples were invalid due to movement of the fruit or instrument, as indicated by sharp spikes in spectral curves as opposed to smooth curves in valid spectra (Figure 1). The invalid spectra were eliminated from the analyses.

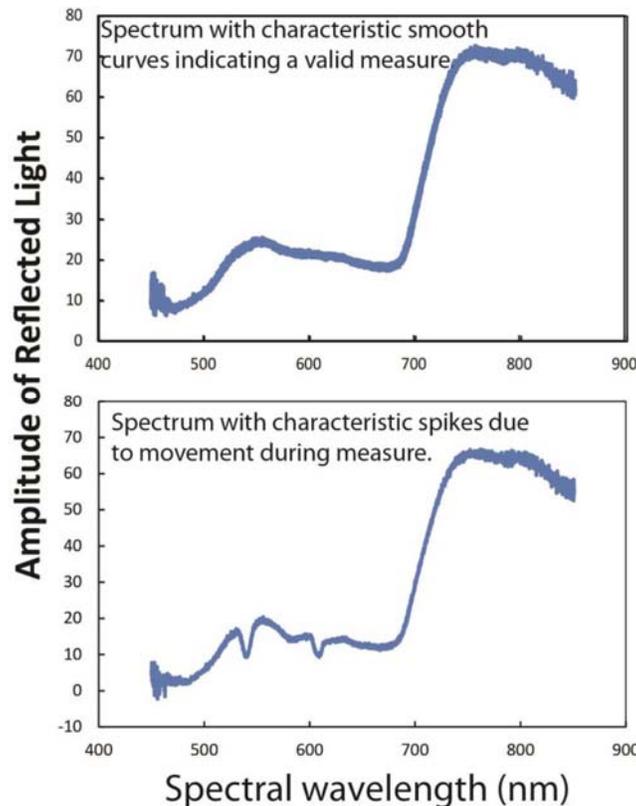


Figure 1. Spectral outputs showing a valid measurement with no movement

during measure and an invalid measure with characteristic spikes associated with movement. The two spectra were obtained for avocado samples from the neck dorsal samples from experiment two.

The analysis of the spectra led to the selection of spectral light reflectance values at 670 and 740 nm for calculation in a model. The model is very similar to that used by the DA meter for measuring chlorophyll in apples and pears. Values at 670 nm are subtracted from the values at 740 nm to yield a reflectance difference index. That index was then regressed against the dry matter contents measured. Results for the equatorial measures (Figure 2) were quite different than those for the neck tissue (Figure 3).

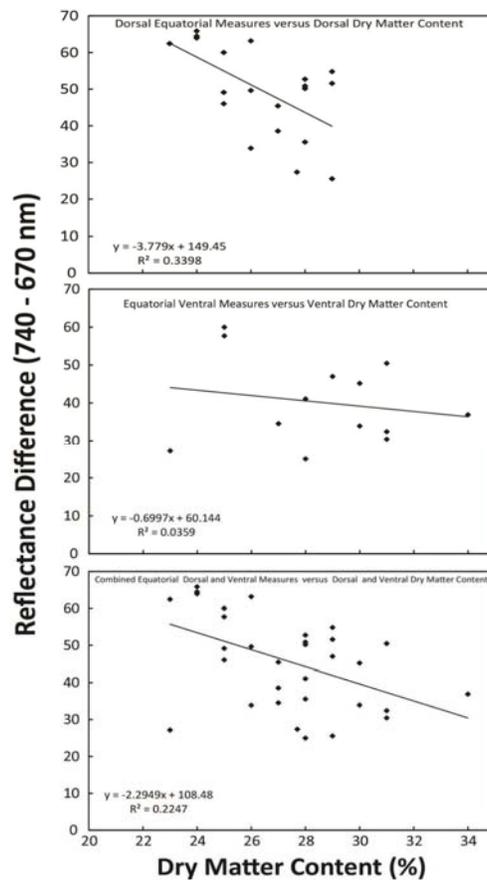


Figure 2. Regression of reflectance difference index values measured at the equatorial section of the avocado against dry matter contents of dorsal and ventral sides of the fruit. The bottom panel indicates the regression for the combined data from the top two panels.

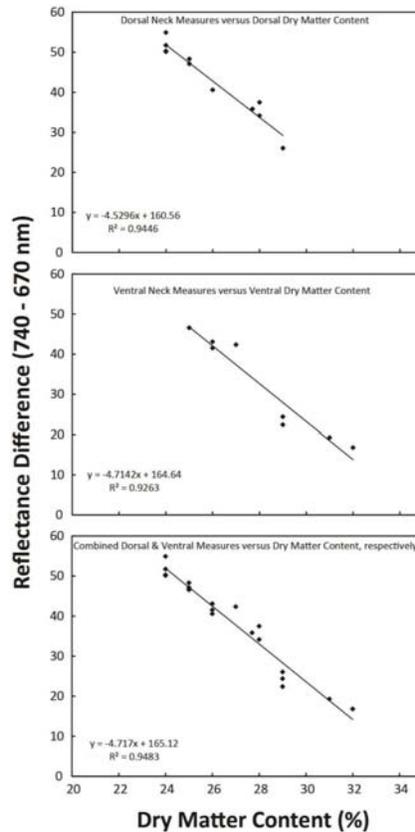


Figure 3. Regression of reflectance difference index values measured at the neck section of the avocado against dry matter contents of dorsal and ventral sides of the fruit. The bottom panel indicates the regression for the combined data from the top two panels.

The data from Figure 3 shows that the neck tissue can provide spectral data that will correlate strongly with the dry matter content of the avocado. The model is similar for both dorsal and ventral tissue (Figure 4) as indicated by the fact that the combined model in the bottom panel is as strong as the individual models in the dorsal and ventral measurements. It is strongly recommended to move forward with developing a protocol to measure neck tissues using the reflectance spectrometer developed by Denis Charlebois.

Why are the neck tissue measures more reliable than the equatorial tissues? Figure 5 shows that the flesh thickness at the equatorial regions can vary a large amount. A spectrometer light penetrates the tissues by at least 1 cm and so the variances in flesh thickness at the equator of the avocado can produce artifacts that lead to false measures. The neck tissue is sufficiently thick that the spectrometer is only measuring flesh and so the readings are reliable if there is no movement with the measurement. This last comment is very important, since it is clear that movement at the time of measure will lead to false readings. It is important to develop a head for the instrument that will ensure that there is no movement at the time of reading. Alternately, an instrument that only measures reflectance at 670 and 740 nm could be developed and this would shorten the measurement time – reducing the chance of movement during measures.

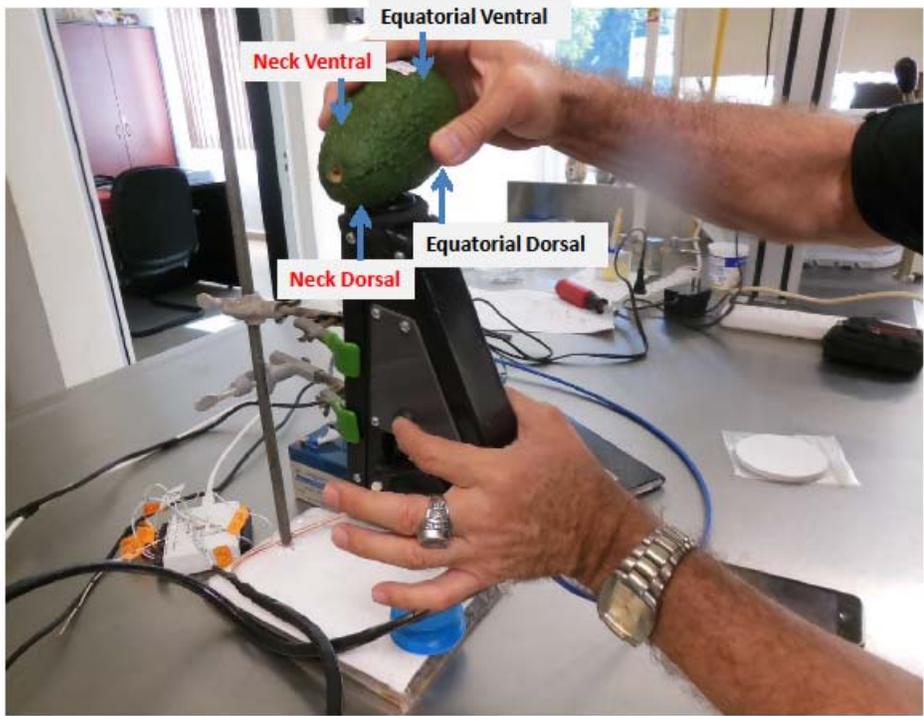
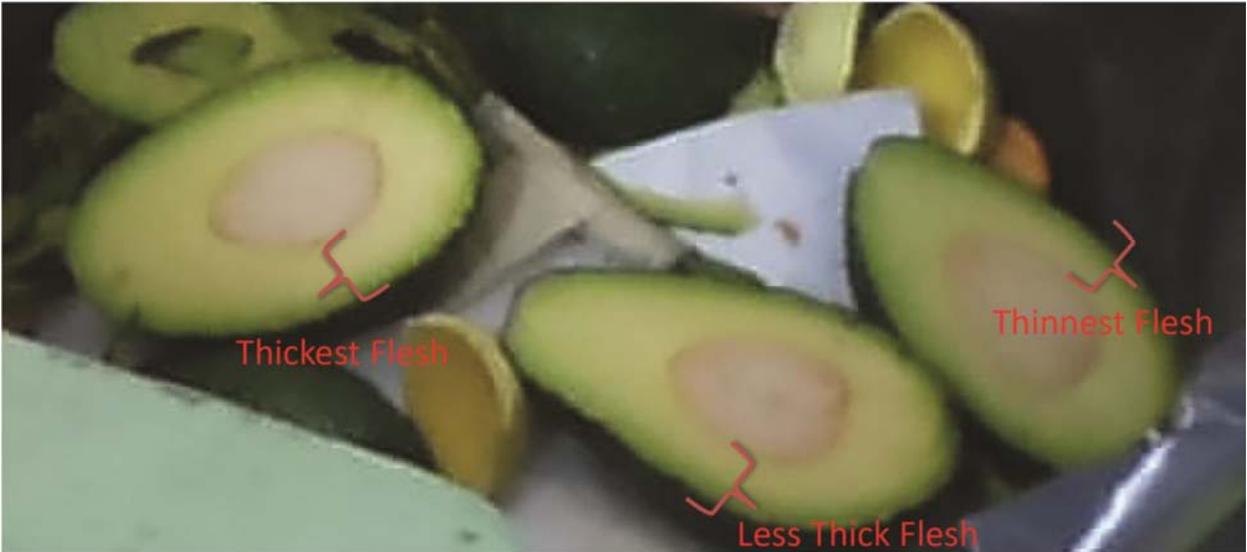


Figure 4. Regions where measurements were made

Figure 5.

Photo showing the variation in flesh thickness of avocados at Agro Gonzalez avocado packinghouse on October 15, 2014. Note that the neck flesh is uniformly thicker than the flesh at the equatorial section of the fruit.



In summary, the data are encouraging to move ahead to develop the use of reflectance spectrometry for estimating dry matter content of avocados grown in Mexico.

The proposed Action Plan for 2015 is as follows:

Activity	Expected result	Date completed	Responsible	IICA	INIFAP, AAFC, ARS/USDA (In-kind)	Industry
Evaluating avocado maturity using spectral analysis (670/740nm).	Correlate NIR with dry matter and other parameters.	September 2015	J. Osuna, P. Toivonen, S. Salazar, R. Goenaga.	\$5,000 (estimated)	\$19,000	\$10,000
Improve and update the taskforce web site.	Disseminate Taskforce accomplishments.	March 2015	R. Goenaga, S. Salazar, P. Toivonen, J. Osuna,	\$0	\$5,000	
Taskforce meeting.	Discuss current research results; Prepare Action Plan 2016.	September 2015.	R. Goenaga, S. Salazar, P. Toivonen, J. Osuna,	\$10,000	\$10,100	
Total				15,000	\$34,100	\$10,000

As a request from Dr. Priscila Henriquez a listing of the Taskforce accomplishments since she started her tenure as Executive Secretary is described below.

Major Accomplishments (2009-2014)

I. Outreach

Output: a webpage was developed and provides technical and non-technical information to customers and stakeholders involved in tropical/subtropical fruit production, quality and safety was developed and is continually updated. The webpage is in three languages and contains over 75 presentations and publications made by members of the taskforce on various subjects related to fruit quality and safety. Impact: Webpage serves as source of technical and popular information on tropical/subtropical fruits to growers, packinghouse managers and consumers.

Output: Task Force members have had several meetings with avocado growers and their organizations in Mexico and California since 2009. TF recommendations have been made not just to produce more fruit of superior quality but to improve their marketing protocols as well as to update their web pages to disseminate information on avocado and on recipes to eat them. Avocado growers have implemented this recommendation and webpages were updated (e.g. <http://www.apeamac.com/>). Impact: The taskforce has been instrumental in providing recommendations to improve avocado grower's webpages to enhance marketing.

II. Research

Output: Significant research with many tropical/subtropical fruit crops has been conducted in the areas of agronomy, horticulture, plant nutrition, postharvest physiology and handling particularly in areas impacting production, quality and safety. Impact: Recommendations resulting from this research were made and information is now available for use by Extension Agents and commercial growers.

Output: Development of a prototype portable spectral analyzer to measure avocado maturity *in-situ* and non-destructively. Impact: Dry matter is a key parameter in determining avocado maturity and quality. This research indicated that it is possible to develop a quick nondestructive technique for measuring avocado dry matter by spectroscopy and hence improve postharvest quality.

III. Training

Output: Courses and Workshops to students, professionals and growers for increasing productivity of various tropical and subtropical fruit crops have been offered on various topics. Impact: Over 700 professionals and growers trained in Mexico and the U.S . Forty-eight Bachelor degrees, 11 Master of Sciences degrees and two doctorate degree pertaining topics affecting tropical fruit production have resulted through interaction with Taskforce members.

Future Plans:

Our 2012-2015 action plan continues to be in effect assuming funding is adequate. Activities under this action plan include:

1. Evaluation of mango maturity in mango cultivars using visible-near infrared spectral reflectance. NOTE: additional fruit crops may be now added in the near future.
2. Field evaluation of NIR spectral analysis protocol and development of a portable spectral analyzer to measure avocado maturity *in-situ*.
3. Continuously improve and update the taskforce web site with relevant information pertaining Taskforce mission.
4. Establish linkages with other PROCIS that may result in research collaboration.
5. Present accomplishments and future plans of Taskforce to Board of Directors.
6. Conduct annual meeting of Taskforce and present accomplishments of Taskforce to scientific community at appropriate scientific meetings.

7. Publish in scientific journals results from Taskforce research.

Other Activities:

1. A workshop took place from May 13 to 16, 2013 in Port-au-Prince, Haiti as part of the project *“Revitalizing a Cherished Crop: Mango Chain Development in Haiti”*, implemented by IICA, USDA-ARS and INIFAP to train Haitian professionals on the best practices for production and postharvest handling of mangoes, the country’s primary export. Fifty two Haitian professionals attended the four day seminar to discuss the best practices for production, new methodologies to estimate optimal harvest times, and many other topics relevant to the business. Among the attendants were fifteen students in their final year of undergraduate program, who will become technical advisors to the producers. They discussed the importance of implementing good agricultural practices (GAPs) to ensure food safety to lower the risk of contaminating produce with dangerous pathogens.
2. During July 1-3, 2013, Haitian agricultural specialists from the Ministry of Agriculture, Natural Resources, and Rural Development (MARDN) and fruit producers participated in a technical mission to Nayarit, Mexico. The delegation of 16 people from the public, private and educational sectors, visited various mango orchards and packinghouses and was able to interact with producers, exporters, and processors of fruit as well as researchers from INIFAP. This trip was part of a capacity-building project for Haitian professionals sponsored by the Inter-American Institute for Cooperation on Agriculture (IICA) to assist Haiti’s fruit sector in research and development of tropical fruit crop production systems and development of new markets for these crops.
3. During July 8-11, 2013, Haitian agricultural specialists from the Ministry of Agriculture, Natural Resources, and Rural Development (MARDN) and fruit producers participated in a technical mission to the USDA-ARS Tropical Agriculture Research Station (TARS) in Mayaguez, Puerto Rico to learn about the tropical fruit research program at this location and to visit local fruit producers and processors. This trip was part of a capacity-building project for Haitian professionals sponsored by the Inter-American Institute for Cooperation on Agriculture (IICA) to assist Haiti’s fruit sector in research and development of tropical fruit crop production systems and development of new markets for these crops. During this visit Haitian personnel visited USDA-ARS experimental plots and laboratories dealing with research on tropical fruits such as dragon fruit, rambutan, lychee, longan, papaya, carambola, plantain, banana, mango, etc., and commercial farms of mango, papaya, citrus, Spanish lime, plantain and others. The Haitian delegation agreed on the need to develop a collaborative research program with institutions such as the USDA-ARS-TARS and in seeking opportunities for professional training at TARS focused on the short term needs such as development of improved production systems and pest and disease management for tropical fruit crops.

4. A PROCINORTE mission of the Task Force on Tropical and Subtropical Fruits was carried out in Mexico from August 30 to September 6, 2013. The general assembly meeting of the Task Force took place on September 3, in Queretaro, Mexico. As part of the mission, members of the task force attended the Annual meeting of the Interamerican Society for Tropical Horticulture (ISTH). Five presentations were given on research conducted by members of the taskforce. A field trip to an avocado farm was made. Methods to assess fruit maturity in avocado orchards were discussed and considered for future research by the task force.

Recommendations:

This taskforce has remained very active and members have engaged in collaborative research which has produced research findings that are useful to industry and growers. Now that a Canadian delegate is fully committed to this Taskforce, continuation of projects and initiation of new ones can take place. Communication between Taskforce members is outstanding. However, for this Taskforce to remain effective it is important that all representatives be adequately supported by their respective organization and by IICA. A solution on how to Taskforce members can receive funding to continue current work must be found. In-kind involvement alone will not suffice. Taskforce members believe that about \$50,000 in discretionary funds are needed to operate. This amount will cover all operational costs including travel. However, Taskforce members are in agreement that this amount will not be needed every year. Hence, we propose a "floating fund source" controlled by the Executive Secretary for use by all Taskforces for years in which in-kind help is not sufficient to accomplish a given project. On occasions like this, monies could be requested to the Executive Secretary one year early with proper planning.

Ongoing Task Force research is based on work agreements with avocado and mango producers, packers and traders. In some cases this collaboration started in 2004. They trusted Taskforce's commitments and have partially supported our research with in kind assistance. We must honor these agreements and if this is not possible we are under obligation to inform to our stakeholders about this decision so as not to create wrong expectations.