

**A study tour of the
American chestnut
industry with a focus
on peeling equipment,
October 2007**

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Tweenhills Chestnuts

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peeling equipment**

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Tweenhills Chestnuts

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Media Summary

Chestnut production in Australia is increasing and it is essential to boost domestic consumption to ensure the long-term viability of the industry. Value adding may hold the key, providing a use for all chestnuts, including small nuts and those that exhibit poor peelability. Peeling of chestnuts, the removal of the outer shell as well as the inner pellicle is usually one of the first steps in the processing chain. This is not a trivial task.

The American chestnut industry represents an attractive alternative to the European experience, the subject of previous chestnut industry study tours. The American industry is young and quite small; it is in a state of renewal following the demise of the native American chestnut tree population in the early 1900's after introduction of chestnut blight. In contrast to the Australian industry there is a strong focus towards value adding of chestnut products. There has been a concerted effort to tackle the key processing impediment, removal of shell and pellicle. Also the American industry is fortunate to have linkages to chestnut research programs within the University of Missouri and Michigan State University. Importantly the research group based at Michigan State University, in association with the Chestnut Growers Inc cooperative, has procured a chestnut peeling machine (for fresh chestnuts) from Italy. Since 2004 they have experimented with this equipment, adapting it to cope with the vagaries of the varieties, including non-peeling ones, grown in the USA.

John and Heather Kane, 'Tweenhills Chestnuts' Hoskinstown NSW, have undertaken a study tour of the American chestnut industry with the following objectives:

- To investigate the chestnut peeling machine operated by Michigan State University.
- To develop linkages with scientists working on chestnut-specific projects and to develop networks with American growers.
- To attend regional chestnut festivals and sample the value added chestnut products.

Overall the tour was very informative and instructive. Meetings were held with growers (many involved in the production of value added products) and researchers across 6 states during October 2007. A highlight was being able to see the chestnut peeling machine in full operation. It works exceptionally well, producing a pellicle-free kernel. Growers involved in value adding freely discussed the processes used as well as some of the pitfalls they had encountered. All groups that we met with were keen to continue the interaction with the Australian industry, with scientific collaborations and possibly a joint Australian-US meeting.

Expected Outcomes and Achievement

To visit the American chestnut industry and investigate the chestnut peeling machine operated by Michigan State University.

a) The American Industry

To gain an impression of the American chestnut industry we visited

- 3 growers in Portland, Oregon
- 2 growers in Washington State
- 1 grower in Carrollton, Ohio
- 4 growers in Michigan plus visited 1 other grove
- 3 growers in California
- 2 university research stations (The University of Missouri and Michigan State University)
- 1 chestnut festival

The following comments are a general overview of the American industry and represent our summation based on discussions and visits with growers from different regions of the USA. There are subtle differences between methods used in different regions and unlike the Australian industry there is no single set of guidelines available for distribution to growers. American growers seemed envious of our local association and its linkages with government.

As regards the locations of orchards, high rainfall (up to 1200mm) seems to be the common factor in the industry, though distribution of rainfall varied from 'evenly distributed' (Missouri) to 'none in summer' (Oregon). A variety of soil types (deep basalt in Oregon; deep river silts in Missouri; sandy soils in Michigan) were seen and a range of elevations were described.

We learnt that the American chestnut industry is based on Chinese chestnut (*Castanea mollissima*) or interspecific chestnut hybrids (*C. sativa*, *C. dentata*, and *C. mollissima*), the main one being 'Colossal'. Colossal has a number of good characteristics (pleasant taste, good colour, shiny nut) but the nut is subject to pellicle intrusion. Most growers expressed some disappointment and frustration with the management of this cultivar- it being difficult to prune to yield reliable results.

Colossal is the mainstay of the industry in Oregon and California, though varieties familiar to Australian growers (Bouche de Betizac and Italian Marone-styles) are being introduced. In the other regions visited there is a mixture of Colossal and Chinese chestnuts grown. Supply of alternatives to Colossal has been restricted by limited availability of suitable grafted stocks from nurseries and limited varietal testing. Chinese chestnut is grown mainly in the mid-west and eastern states due to its resistance to chestnut blight. In general, the Chinese chestnut is smaller, peels easily, is a golden colour and has a reasonable taste. However there is a lot of variability in the size, colour and quality of the Chinese chestnuts as these are generally propagated from seed.

Production is increasing due to a combination of increased plantings and increasing age of the trees. However production is still small (<200 tonnes) and there is unmet demand for chestnuts in America, with greatest demand being around Thanksgiving and Christmas. Growers face competition from imports from Europe and Korea. The poor quality of the imported nuts has a

detrimental effect on consumer acceptance of chestnuts in general. 'Buy local' is used as a marketing ploy to counter this. Most growers direct market their fresh nuts using the internet or local 'produce stores' largely because of difficulty accessing wholesale markets. Average prices are \$3.50-\$5.00/lb depending on size. Those using internet sales use the US postal system and take advantage of a flat-rate charge postage box. Storage and cooking instructions are included in the sales package. The gluten-free attribute of chestnuts is used as a promotional selling point by most growers, particularly those producing value added products.

Generally mesh bags are used for small quantities (<5kg) and polymesh bags are used for larger weights. Nuts are shipped unrefrigerated. While there is an acceptance that good quality is important, the industry lacks consensus on the description and size groupings of chestnuts and we encountered at least 3 significantly different descriptions for similar sized nuts.

Although the American industry might be described as uncoordinated, it is small enough to support each independent grower doing their own thing. Each grower seems reasonably successful. This is probably because supply has not yet outstripped demand.

Most growers that we spoke to either use mechanical harvesters or are switching to mechanical harvesters due to the difficulty in sourcing reliable labour. Hazelnut and walnut harvesters are the principle machines used and these are readily sourced from the used-machinery suppliers. Grading equipment and cold-storage facilities are limited. Most inspection facilities consist of a flat belt and lack the roller systems that are common in Australian packing sheds. Only a very few of the cold rooms were operating below 4°C and freezer shipping containers were used in at least 2 instances.

Pests and diseases are a common feature of the American industry. Chestnut weevil is a major insect pest; trees must be sprayed regularly to kill adults and nuts should be hot-water treated to kill larvae. The affected nuts show 'worm holes' and these nuts must be removed during the inspection process. Deer, racoons, gophers, squirrels and blue-jays are some of the animal pests.

b) The Chestnut peeling machine

Five days was spent visiting Michigan State University, East Lansing MI. In that time we saw the peeling machine in operation. This machine was purchased by Michigan State University using grant funds from US Department of Agriculture and it is located at a university research station near Jackson, MI. The driving force behind the machine is Prof. Dennis Fulbright. Prof Fulbright argues that even though the chestnut industry is in its infancy in Michigan, it was essential to perfect ways of processing chestnuts and developing value added products before production reaches very high levels, ensuring that growers have sales avenues without being left with unwanted/unsaleable nuts. Basically he recommended planning the marketing of the product before any product was available.

The peeling equipment was purchased from the Italian company Boema as a pilot plant and it



Chestnut peeler showing (L to R) steamer unit, brush unit and inspection table

comprises one line of what is usually a dual-line system. Several modules make up the line. There is a hopper for nuts, a burner unit with internal augers to advance the nuts, a peeler unit with rasp like surfaces to abrade the shell from the nut, a steamer unit where the nuts remain for 2-3 mins before passing onto the brush unit which removes the pellicle and lastly an inspection belt. A portable steam generator supplies steam to the steamer unit and maintains a constant temperature. A preheating module was omitted from the purchase; instead nuts are maintained at 26°C for 24 hours before delivery to the hopper. The equipment works best if graded nuts of similar size are used. The auger speed within the burner unit, the de-shelling unit and the steaming unit is variable, allowing the peeler to be adjusted for nuts of different size or variety. The nuts are not cooked during the process, only staying in each section for the minimal time required to remove the shell or pellicle. Experimentation with different speeds and timing allows the operator to successfully peel small, large, Chinese or Colossal nuts. We were pleasantly surprised to see the deeply invaginated Colossal nuts, which have a reputation as being difficult to peel, emerge from the peeler devoid of all pellicle. The peeled nuts were a rich golden colour.

The machine can peel about 200kg per hour and the aim is to peel 1 tonne per day. Nuts are supplied by the cooperative Chestnut Growers Inc (CGI) in a collaborative arrangement. Currently the peeled product is vacuum packed and frozen, generally in 500g or 2.5kg packs, and sold mainly to restaurants or to individuals using web based sales. One person is required to monitor the peeling equipment and several are needed to inspect and pack the peeled product. It is planned to add a food-standard kitchen to the research facility.



Freshly peeled chestnuts drop into collecting tray



Vacuum packed peeled chestnuts

This peeling machine would be an innovation to the Australian chestnut industry. Members of Prof Fulbright's team have offered assistance during set-up and installation or trouble-shooting at later stages.

To develop linkages with scientists working on chestnut-specific projects and to develop networks with American growers.

We made extensive use of the internet to research potential contacts prior to departure. Our itinerary was modified from that proposed in our application in response to either lack of

availability or lack of response from people. Even so we have managed to initiate the following linkages:

a) Scientists

The American chestnut industry is fortunate to have direct links to 2 university research centres. These research centres have arisen because of conditions within the charter of each university; as State Universities these institutions are required to set aside land to be used for activities that will benefit agriculture in that state.



Dr Ken Hunt (left) and John Kane at the germplasm site

Dr Ken Hunt: The University of Missouri has a research station at New Franklin, MO- The MU Horticulture and Agroforestry Research Centre (HARC). Dr Hunt is a senior scientist at the Centre. Here chestnuts, along with black walnut, paw paw and pecans, are being studied as potential new industries for Missouri. This site is at the edge of the current range for native American chestnuts, and paw paw is a fruit native to the region though not cultivated commercially. The main emphasis is on the selection of cultivars suitable for the region. Dr Hunt has argued that chestnuts can be considered an agroforestry operation- long lived tree that have horticultural and conservation values that must be managed to maximise financial returns.

Dr Hunt's program has been running for 12 years. There are 4 research plots:

- A germplasm site: Here Dr Hunt has collected scion wood from growers from across America and grafted it to a variety of root stocks. Most of the trees are Chinese or Chinese/Japanese hybrids though there are also examples of European (French) varieties. These 'mother-trees' are now 12 years old and the results of yield studies of each tree have influenced the selection of cultivars for further trials on other sites at the research station. The Chinese variety Qing has been selected as a potential cultivar based on taste, peelability and nut size. Resistance to blight was a major factor when recommending Chinese cultivars for the region.
- A Yield trial site where there are multiple plantings of several selected cultivars. The nut yield from each tree is recorded and the suitability of a cultivar is made based on this data.
- A spacing trial site where 3 cultivars have been planted at 2 different densities, either 5m x 5m or 10m x 10m. The 3 varieties have different growth habits: Qing is compact, Willamette is sprawling and Peach is upright. Dr Hunt is trying to determine pruning techniques that can be recommended to growers.
- A grafting trial site: A reliable rootstock that can be used to graft Qing is being sought. Graft incompatibility problems have arisen as a major impediment to the propagation of Qing and a new rootstock is required.

Ken was particularly interested to learn John's views on how to prune the trees on the spacing trial site. This was prompted somewhat by our comments that one of the cultivars, Willamette, had a growth habit similar to the Australian variety, Purton's Pride. A long discussion of the merits or otherwise of particular approaches followed with John describing how he manages

Australian varieties. In the end it was agreed that a 'one size fits all' approach was inappropriate and that different approaches were necessary for the different cultivars and that a different method may be needed depending on the density of planting.

This research centre also operates an intern program which is designed to encourage young students to take up a career in horticulture. A student (high school or college) works on the site for 6 weeks participating in the research programs.

Dr Hunt is keen to maintain an interaction with the Australian industry and to participate in any joint meetings that might be arranged in the future.

Prof Dennis Fulbright is a plant physiologist at Michigan State University (East Lansing, MI) with research interests in Horticultural crops, including nuts. His principle research topic is the biology of *Cryphonectria parasitica* and its control (by introduction of hypovirulence genes). Dennis is passionate about chestnuts and has been instrumental in the development of the industry in Michigan. Currently Colossal is the main cultivar grown in Michigan, mainly because it was the best one available at the time. Some promising trials with Bouche de Betizac have begun.

We were able to attend a seminar at MSU where Prof Fulbright gave an over view of his work for the past 25 years. He described the demise of the native American chestnut (*C. dentata*) population by blight following the accidental introduction of *C. parasitica* to the USA, and attempts to control the fungal agent by the selection of strains that contain hypovirulence genes. After extensive laboratory testing selected strains are tested at a field site at East Lansing. We visited this site. Adjacent to the site is a plot of 15 year old *C. dentata* where selection for trees with inherent resistance to blight is also underway. Trees without resistance die within 1-2 years, while trees carrying some resistance survive for up to 10 years.

MSU has several research stations near East Lansing. The site at Jackson (Rogers Reserve) houses the chestnut peeling machine (see previous section). Another site at Clarkesville is used for studies of post-harvest moulds. This work is done in conjunction with the CGI. The cooperative pays a fee for the use of the cold room facilities and Prof Fulbright's team runs experiments to develop methods for the control of post harvest moulds and internal rots using the nuts owned by the cooperative. At the time of our visit there was a significant external mould problem on one batch of nuts. Hypochlorite is usually used to treat this, but health standard concerns prompted testing of hydrogen peroxide as a control agent. Different concentrations and different duration of exposure were being tested. Samples of nuts were collected before and after treatment for later examination in the laboratory.

We spent a day helping to inspect nuts at this facility. It was apparent that one of the major problems was lack of adherence to strict quality control, in part due to the equipment that was being used. Most of the equipment has been sourced from other industries, particularly the blueberry and apple industry, major horticultural industries in Michigan.

We also met the other members of Dennis' team and discussed their chestnut research projects. One student is analysing the DNA of chestnut cultivars grown in America and another is working on the control of post-harvest moulds and rots. We were able to tell them about the work that had been done by the Chestnut Industry R&D programs in Australia: the DNA Library work and the development of the CALM long-term storage unit. It was a constructive discussion and highlighted the problems common to both industries and the synergies that might be gained by successful collaborations. Another member of the team conducts yield and grafting trials to assess cultivars for potential use.



Prof Dennis Fulbright (L) indicating a blight lesion to John Kane

We were overwhelmed by the generosity and enthusiasm shown by Dennis.

Prof Fulbright is extremely interested in developing links to the Australian chestnut industry and is keen to participate in a joint meeting between the US and Australia.

Greg Miller (Empire Chestnuts) is an environmental scientist with a deep commitment to the propagation of a *C. dentata*/*C. mollissima* hybrid. The aim is to produce a tree with the timber characteristics of *C. dentata* and the blight resistance characteristics of *C. mollissima*. We were shown around the propagation plots and trial plots. Nut yields are monitored and the data used to select potential cultivars for propagation. It is hoped that a successful hybrid could be used for reafforestation projects, especially in areas along the Appalachian Range within the former range of *C. dentata*.

Greg is also interested in using the chinquapin (*Castanea pumila* and *C. ozarkensis*; chestnut species native to US, shrub habit with small burr and single nut) as a model for experiments examining: the timing of flower set, the development of female as opposed to male flowers and factors that affect the timing of nut fill.

He is interested in visiting Australia and establishing links to the Australian chestnut industry.

b) Growers

Every grower that we met was interested in learning more about the operation of the Australian chestnut industry. There was considerable interest in attending a joint US-Australian meeting. In fact our visit was met with warmth and enthusiasm in every region visited. We met the following growers

Oregon:

- Randy & Irene Coleman: A 14 acre orchard, mostly Colossal, established about 22 years ago. Fresh sales only at farm gate, mail order and to local produce merchants. *Phytophthora* is an ongoing problem due to poor drainage. Also grows hazelnuts.

- Ben & Sandy Bole: A 25 acre certified organic orchard, mostly Colossal with Nevada as pollinator. Fresh sales using mail order. Produces a range of value added products. We helped to grade and inspect nuts.
- Chris & Andy Foster: Organic certified orchard, mostly Bouche de Betizac and Marone-style nuts. Fresh sales within the local region.

Washington State:

- Lee & Linda Williams: A 20 year old seedling orchard. Mail order for fresh sales. Produces a range of value added products. Designs and builds all his processing equipment. We helped to inspect nuts.
- Carolyn & Ray Young: A 10 year old Colossal orchard. An innovator in the development of value added products. Internet sales are a mainstay.

Ohio:

- Greg Miller: Established in the 1970's, this orchard is based on Chinese chestnut. Produces about 35 tonnes. Fresh sales direct to the East coast markets and to local produce stores. Mail order also forms a sizeable proportion of his sales. Builds and develops all chestnut handling equipment. Produces some dried chestnuts and small quantities of flour. Other interests include the propagation and sale of nursery stocks of Chinese chestnuts, the collection and sale of chinquapin seed for reafforestation projects. We helped to inspect and grade chestnuts, and harvest and clean chinquapin seed

Michigan:

- Carl Dekleine: A 20 acre 10 year old orchard and a 15 acre 3 year old block based on Colossal with Okei as pollinator (Nevada does not grow well in Michigan). Member of CGI. Also produces sweet and sour cherries, and maple syrup. Carl very kindly took us on a driving tour to another chestnut orchard about 1 hour from his block. It was unique because it had no irrigation and was producing 2.5 tonnes from about 500 6 year old trees.
- Pete Conrads: Approximately 800 tree orchard, most 6 years old based on Colossal. Member of CGI. Also grows asparagus and corn. Carl Dekleine kindly took us to this property; it was an unplanned visit.
- Bill Nash: While Bill produces some chestnuts, mainly Colossal, his principle role is as a nursery man producing chestnut trees for planting. He works closely with Prof Dennis Fulbright in assessing the suitability of cultivars, including *C. mollissima* hybrids, for mass production. There is a stand of *C. dentata* on Bill's farm; it is 25 years old and has suffered only minor incidence of blight.
- Bob & Ginger Rinkel: A 5 year old orchard that has failed to produce any nuts, most probably due to pollination problems. This site has also experienced severe frost events. Member of CGI.

California:

- Polo Ramos: Farm manager at Owl Creek Ranch, Lucienne Grunder's block. A large planting (about 80 acres), approximately 16 years old. A mixture of cultivars

including Colossal, Okei, Bouche de Betizac, and Marasol. Seedling trees were reworked to the desired variety after about 6 years. Annual production is about 17 tonnes. This orchard is threatened by boron toxicity; boron has accumulated over time from the soil and bore water. Colossal appears to be the most susceptible to boron.

- John Girolami: These were the oldest chestnut trees that we saw in America. One block of 400 trees was planted in the 1920-1930's and another block of 400 trees were planted in the 1950's. All the trees have been reworked to Colossal. The family has introduced some innovative pruning practices to encourage nut production. Walnuts are the main crop on this farm, and walnut harvesting equipment is used to harvest chestnuts. All nuts are wholesaled.
- Harvey Correia: This orchard was undergoing major reworking, mostly to Bouche de Betizac and Marone-style cultivars. Some Colossal remains, though this is pruned heavily to achieve large nut size. Harvey operates a successful mail order business. We helped to pack nuts ready for despatch.

To attend regional chestnut festivals and sample the value added chestnut products.

a) Chestnut Festival

The American chestnut industry runs 'National Chestnut Week' in the second week of October. This year, unlike previous years, most regions held a festival on the same Saturday, this year on October 13, and as a consequence we were only able to participate in one festival, in Missouri. Other venues are at Allen Creek Farm Ridgefield, WA and Cadillac, MI.

The festival in Missouri is advertised as the 'Missouri Chestnut Roast' and is held at the Horticulture and Agroforestry Research Centre, the principle research site of the University of Missouri, at New Franklin, MO. It has been running for 5 years. This year it rained for the first time, making it very difficult for exhibitors and patrons and reducing the number of visitors. The chestnut roast is used as a draw card to highlight the activities of the research station.

Roasted chestnuts were available all day long and these were sought enthusiastically. These were bright yellow, had a pleasant taste (though not as intense as De Coppi Marone, the variety we roast in Australia) and peeled very easily. Fresh chestnuts and chestnut trees were available for purchase. Cooking demonstrations of ways to use chestnuts by two executive chefs were provided - dishes prepared included chestnut hummus, chestnut and parsnip soup and deer with a chestnut coating. The hummus was very tasty and was a real hit with everyone that sampled it. Wood turners were also on hand to show the unique grain lines of chestnut wood.



Chestnut roasting at 'Missouri Chestnut Roast'

Other regional produce was featured at the festival and included black walnuts, hickory nuts, pecans, Ozark pork, elk and goat products. There was also an information tent where the

activities of the research centre were on display. Here a display of international processed chestnut products, including some packaging from 'Cheznuts' (an Australian producer) was arranged.

We took the opportunity to talk to Tom Wahl, a grower from Iowa with fresh chestnuts for sale. Tom grows Chinese chestnuts and has done so for about 14 years. He has adopted what he terms an 'integrated approach', inter-planting the chestnuts with hickory, pecan, paw paw and berries so as to recreate a forest effect.

b) Value added Products

Many of the growers that we visited were also producing value added products. These products had usually been developed in isolation by trial and error, often using novel production methods, and with different motivating factors. Dried chestnuts were the starting point for most products, the exception was the frozen-peeled product packed by CGI (in association with MSU). Flour was a popular product.

Ben & Sandy Bole (Ladd Hill Orchard): An increase in the volume of smaller nuts was a motivating factor for moving into value-added products. About 2.5 tonnes of dried chestnuts are produced each year. Chestnuts are dried using a walnut drier operated in a nearby town. It takes about 7 days to completely dry the nuts. The shell is removed by repeatedly passing the nuts through a series of stainless steel rollers. Pellicle is removed by repeatedly passing the shelled nuts between 2 abrasive belts. Quality standards are very high and nuts with residual pellicle are returned to the system until all the pellicle is removed. This is a time consuming and slow process. Flour is made using equipment owned by Carolyn & Ray Young (see below). The Bole's market chestnut flour, dried chestnuts, chestnut scone mix and wild rice/ dried chestnut mix. Mail order (via the internet) is popular and organic and gluten-free tags are big selling points.

Carolyn & Ray Young (Allen Creek Farm): A desire to increase the financial returns, and even out the income stream, from the farm was a factor in this group developing a range of value added products. Most nuts are dried and further processed; fresh nuts are only sold when there are good quantities of large nuts. Nuts are dried then transported to Ladd Hill Orchard for removal of shell and pellicle. Flour is milled at Allen Creek Farm. Fine grade flour is produced when the nuts are ground using a hammermill. There is an initial pass using a coarse screen, followed by a second pass with a fine screen installed. It takes 2-3 hours to produce 25 kg of flour. For a slightly coarser mix a stone mill from Austria is used. This mill suffers from having a narrow feed, making flour production a slow process. Both techniques produce a beautiful, fine, sweet flour. The flour is used as the base for a chestnut bread mix, pancake mix, bisque mix, and chowder mix. Some products are also available as gluten-free mixes. Substantial quantities of flour are sold to a Canadian gluten-free bakery. Internet marketing is the principle selling route.

Lee & Linda Williams (Trails End Chestnuts): Lee has set himself a personal goal to develop as many uses for chestnuts as possible. All the equipment that is used to process the chestnuts has been constructed by Lee. Chestnuts are slowly dried over several weeks before being passed through a roller system to remove the shell. Most of the pellicle is also removed in this step; residual pellicle is removed using a novel centrifugal device that is powered by air pressure. Dried chestnuts are broken between sets of rollers (Lee calls this a 'cracker') before being screened over mesh grids. The smallest pieces are ground in a stone mill to produce flour. It also

tasted nice and sweet. Larger pieces (up to 2mm) may either be ground into flour or roasted to produce a coffee-substitute. The largest pieces (2-5mm) are used for beer making (beer chips) or packaged as crumb coatings. Lee has developed a gluten-free beer (using beer chips) but this is not available for commercial purchase. However he has made his brewing technique readily available on the internet. Waste shell material is used as dust suppressant on the farm roads. Internet marketing is the principle sales route.

Greg Miller (Empire Chestnuts): Nuts, about 0.5 tonne at a time, are dried slowly over a 3 week period until there is a 50% reduction in weight. These partially dried nuts are de-shelled by firing the nuts at 300 ft/sec at a piece of wood. Shell debris is removed by an air leg. Peeled nuts can be further dried before grinding into flour, though whole dried nuts are reserved for sale to restaurants. Broken nuts are generally ground into flour using a knife mill. Internet sales comprise the main sales method.

Chestnut Growers Inc: This cooperative is vacuum packing and freezing peeled chestnuts (see 'The Chestnut peeling machine' section). These are being distributed to chefs across America. Shipments are sent on dry ice and we saw the packing of a 200kg order ready for despatch to Las Vegas. Other products are being developed. Chestnut chips, wafer thin slices of peeled chestnuts that have been dehydrated, are being readied for sale. These are quite tasty and suitable as a snack product. Breadings (or chestnut crumbs) are also under development. A future aim is to develop a shelf-stable peeled chestnut that does not require freezing.

Results of discussions

There was considerable interest in the prospect of a future joint meeting between the US and Australian chestnut industries. New Zealand was added to the list also: its industry is also young and under-going development.

The US industry is keen to learn about the horticultural and management practices used in the Australian chestnut industry. A joint meeting would be one way to assist the exchange of information. Discussions will continue with Chestnuts Australia Inc, the peak industry body for the Australian industry to determine if there is sufficient interest to follow through with the idea and to determine a suitable time.

Discussions with scientists were very useful. We gained an insight into the key issues facing the American industry and the ways that it is tackling these issues. Future collaborative projects are a distinct possibility. It will be up to the local Australian industry to further develop the linkages that we have forged. Certainly the group at Michigan State University is interested in taking a collaborative approach to solving problems that are common to both industries.

The American producers were extremely open and frank when discussing their value added products. It was clear that each producer had worked hard and was proud of their efforts. They had used the available resources, especially IT technology, to market their products in what could be considered a 'smart' approach.

We also had some discussions with members of the CGI cooperative. We learnt about the composition, structure and operation of the cooperative. As there is a move to form a cooperative in Australia this information will be passed onto that group.

Implications for Australian horticulture

This study tour was extremely valuable. After reviewing what we saw and heard we compiled a list of factors that we consider likely to affect the Australian chestnut industry. Some of these mirror points previously raised in the current industry strategic plan.

- Australia must retain high quarantine standards. Introduction of any of the insect pests or Chestnut blight would decimate the Australian industry.
- The importance of appropriate branding of product is important. Labelling of Organic produce was also a key selling point, as was a 'buy local' approach. Country of origin labelling will be important, allowing the consumer to choose locally grown produce.
- Although the chestnut processing industry is small in America, and not likely to be a serious competitor within the Australian market, European and Asian imports do represent a serious threat. Similarly Chilean imports represent a serious threat; chestnut production is increasing rapidly and the cost of production is less due to cheaper labour costs. This is particularly important in view of Free Trade Agreements that are being negotiated.
- A set of quality standards and industry guidelines must be strongly promoted. It was clear that the US chestnut market lacks consensus on sizes and quality standards. While the Australian industry has guidelines and standards, lack of adherence to these standards by a small proportion of growers will damage the industry and eventually destroy it.

- Processing technology must be adopted. This would allow the Australian industry to move away from the reliance on sales of fresh product through the wholesale market. The Australian industry needs a peeling machine similar to that operating in Michigan. It was especially helpful to see the equipment in operation and realise just how effective it was for removing shell and pellicle. To remain viable, and competitive, this peeling technology must be adopted. This equipment is readily available. It requires gas, water and electrical connections as well as a shed to house it. The stumbling block may well be that it requires a capital investment of around \$250,000 to get it up and running.
- Development of value added products derived from dried chestnuts must be encouraged in Australia. The American chestnut industry, even though it has small levels of production, has demonstrated that such value added products can be produced if there is sufficient determination. Most of the dried chestnuts we saw were de-shelled and the pellicle removed using equipment that had been invented by the grower, indicating that processing expertise can be acquired. The alternative is to develop links with food processing companies. However because chestnuts are not a mainstream nut, it is likely that processing may only be done by smaller or select businesses. There is certainly sufficient demand for these products.
- It is crucial to maintain contact with scientists and growers for the exchange of information. Many of the problems we have in Australia are common to the industry world wide. Sharing of information may help to find solutions. Australian growing techniques are first class and the American industry is keen to learn from our industry.
- Selection, propagation and distribution of new cultivars with desirable characteristics must be encouraged. The pollinator nut used in the US industry is frequently not harvested and is left for animals. In some states it was difficult to find sufficient quantities of propagated material to plant and there was reliance on only 1 or 2 nurseries for stocks. The consumer is willing to pay for a good product and will only return for a second time if the experience matches their expectation. The best nuts must be available.
- The use of direct marketing using the internet was very strong in the USA. Most of the US growers were very IT aware with websites and web-sales to promote their products.

How the information gathered will be disseminated

The information will be provided to industry in the following ways:

- At least one presentation to the annual industry meeting. The presentation will include many photographs and provide a summation of our experience. The meeting is usually held in September each year and we have advised Chestnuts Australia that we will be available to give a presentation.
- At least one written presentation in the industry newsletter, 'Nuts & Burrs'. We are planning to prepare a summary article for the pre-harvest addition, probably distributed in March 2008, and other specific articles may also follow.
- Submission of a written presentation to the 'Nutgrower', the Australian nut industry newsletter.

- Information on the structure, composition and operation of the CGI cooperative will be passed onto the appropriate Australian industry members.

Itinerary

<u>DATE (2007)</u>	<u>CONTACT</u>	<u>ACTIVITY</u>
October 5		Depart Canberra, fly to Portland, OR via Sydney and San Francisco Overnight accommodation Portland
October 6	RC Farms, Ladd Hill Orchard	Drive to McMinnville, OR. Inspect orchard and harvesting equipment Discuss marketing Drive to Ladd Hill Orchard, Sherwood OR Overnight accommodation
October 7	Ladd Hill Orchard	Inspect harvesting equipment Participate in grading activities Tour of processing facility Overnight accommodation
October 8	Chris Foster Trails End Chestnuts	Drive to Portland, OR Discuss varietal improvement issues and marketing Drive to Trails End Chestnuts, Moses Lake WA Chestnut beer tasting Overnight accommodation
October 9	Trails End Chestnuts	Participate in inspecting nuts Tour of processing facility View demonstration of flour making Tour of orchard, discussion of varieties
October 10	Allen Creek Farm	Drive to Allen Creek Farm, Ridgefield, WA Inspect orchard and harvesting equipment Discussion of pruning techniques Tour of processing facility View demonstration of flour making Discuss direct marketing and web sales Overnight accommodation
October 11	Allen Creek Farm	More extensive tour of orchard Rest afternoon Overnight accommodation Portland
October 12		Fly from Portland to St Louis via Phoenix Overnight accommodation St Louis
October 13	(New Franklin, MO)	Drive to New Franklin, MO Missouri Chestnut roast Taste roasted chestnuts, other chestnut products Talk to growers Overnight accommodation Boonville, MO
October 14		Rest day Overnight accommodation Boonville, MO

October 15	Dr Ken Hunt	Tour of University of Missouri Horticulture & Agroforestry Centre. Inspect germplasm plots and other field sites. Discussion of pruning techniques Commence drive to Carrollton, OH via Wapello, IA. No accommodation, so continued driving. Overnight accommodation Geneseo, IL
October 16		Continue drive to Carrollton, OH. Overnight accommodation Seville, OH
October 17	Empire Chestnuts	View grading of Chinese chestnuts View treatment of chestnuts for weevil larvae Walking tour of Chinese chestnut orchard Overnight accommodation
October 18	Empire Chestnuts	Assist with grading and inspection of chestnuts Assist with harvesting of chinquapins Tour of processing facility Tour of chestnut breeding trials- discussion of experiments to breed a blight resistant strain Packing chestnuts ready for sale Overnight accommodation
October 19	Empire Chestnuts	Walk through experimental trial plots Visit local retail market (Whitehouse Apple Market, Canfield OH) Commence drive to Michigan. Overnight accommodation at Fremont, IN
October 20	Carl Dekleine	Drive to Hudsonville, MI Walking tour of farm Overnight accommodation
October 21	Carl Dekleine	Discussions about organisation of CGI co-operative Escorted tour of chestnut orchard at New Era and walking tour of Pete Conrads' orchard at Ludington, MI. Overnight accommodation
October 22	Prof Dennis Fulbright	Drive to Clarkesville, MI- MSU Research Station & receiving station for CGI chestnuts; familiarisation with location and setup Attend seminar MSU, East Lansing Overnight accommodation
October 23	Prof Dennis Fulbright	Drive to Clarkesville Assisted with the inspection of chestnuts Assisted with the bagging of nuts ready for sale Participate in experimental treatment of nuts for post-harvest moulds Walking tour of experimental chestnut site Overnight accommodation

October 24	Nash Nurseries	Drive to Owosso, MI Tour of chestnut propagation area, glasshouses and orchard including <i>C. dentata</i> stand Escorted tour to local chestnut orchard- discussion of varieties and maintenance Return to East Lansing, overnight accommodation
October 25	Prof Dennis Fulbright	Drive to MSU-Rogers Reserve Jackson, MI View chestnut peeling equipment in operation, detailed explanation of operation. Inspect & pack peeled chestnuts Tour of experimental plots (chestnuts and paw paw) Tasting of processed chestnut products Return to East Lansing, overnight accommodation
October 26	Prof Dennis Fulbright Bob & Ginger Rinkel	MSU Campus, East Lansing MI Tour of experimental plots Meeting with laboratory members to discuss R&D projects undertaken by Australian chestnut industry. Provide advice on operation of CALM storage units Drive to Leslie, MI Discussion of processing of dried chestnut products Walking tour of orchard- severe frost damage, pollination problems Return to East Lansing, overnight accommodation
October 27		Drive to Detroit. Fly to San Francisco Overnight accommodation San Francisco
October 28	Owl Creek Ranch	Drive to Waterford, CA Tour of orchard- discussion of varieties and irrigation management, microelement toxicity Tour of propagation beds Overnight accommodation Lido, CA
October 29	Girolami Farms Correia Chestnut Farm	Drive to Stockton, CA Tour of orchard, discussion of pruning techniques Drive to Isleton, CA Assist with packaging of nuts for mail-order sale Discussion of web sales Tour of orchard, discussion of varieties and pruning techniques Drive to San Francisco, overnight accommodation
October 30		Rest Day Overnight accommodation San Francisco
October 31		Depart San Francisco for Canberra via Sydney

Recommendations

1. Australian growers should be encouraged to see first hand just how the chestnut industry operates in other countries. This trip was extremely worthwhile. We have learnt a lot, and set up the beginnings of a network with growers and scientists in the USA.
2. Peeling equipment similar to that being used at MSU should be operating in Australia. It was invaluable to see the peeling equipment in operation. The equipment is impressive, producing a pellicle-free, whole nut. Investment in this direction should be encouraged. Future contact with the manufacturer, Boema, in Italy may be required.
3. Flour milling options need to be investigated. We saw at least three different pieces of equipment being used; stone mills, hammer mills and knife mills. A follow on from this is the development of products where chestnut flour is used as a base ingredient for a range of other, easy to prepare foods such as pancakes, breads and soups. These could target key marketing areas related to health and diet such as gluten-free.
4. Links to processing industries must be established. This would encourage the transfer of information between the two sectors and may ultimately result in processed chestnut products reaching a wider market.
5. Technology should be better utilised by the Australian industry. This is particularly applicable to the use of the internet for sales to non-metropolitan areas.

Acknowledgments

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