Western Chestnut Growers Assn.

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A Major Advance in Chestnut Storage with CALM Storage Technology

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The CALM storage method was presented at the International Chestnut Congress, Oct 20-23, 2004, in Chaves, Portugal.

Summary

This storage system was developed over the last 3 years by Sydney Postharvest Laboratory with funding assistance from CGA (Chestnut Growers Australia) and HAL (Horticulture Australia Limited). The basic design has been finalized and is now protected by a patent.

- The basic principle is storage of chestnuts under high carbon dioxide levels (>15%) with adequate oxygen levels (>4%) maintained.
- This system enables excellent long term control of rots in chestnuts without use of chemicals for periods of up to 12 months, a very considerable increase over the up to four months currently obtained commercially.

Introduction

The basic concept of the system is that certain crops, like chestnuts, can tolerate high carbon dioxide in the storage atmosphere (15 – 23%) when stored in a cool room. High carbon dioxide in the storage atmosphere has the benefit that it prevents growth of storage molds and insects. Low oxygen gives some slight benefit to storage life of chestnuts (however, it has little effect on storage molds and insects).

Air contains 20.95% oxygen (most of the rest is nitrogen)

All fruits and vegetables use oxygen and convert it into carbon dioxide. By sealing up chestnuts within a plastic bag, oxygen is changed into carbon dioxide. However, a certain level of oxygen is required to keep the chestnuts healthy. Several year's research has found that for chestnuts in cool storage, a good balance of the highest level of carbon dioxide and a safe level of oxygen is achieved by controlling the oxygen within the bag to 4%, under these conditions carbon dioxide levels are about 17%.

For the system to operate correctly, it is essential that the chestnuts are stored below 2°C (-2 to 2°C), they are completely sealed in the plastic bags and base unit and that the CALM unit is maintained on power and operating within the range of 3.5 to 7% oxygen at all times.

Development Leading to Current Model

This technology was developed out of very promising controlled atmosphere work that was done supplementary to the chestnut research project examining sanitizers and packing funded by CGA and HAL. The research done to develop this technology has involved lots of work on the best oxygen/carbon dioxide levels for chestnut storage balancing performance and **(cont. page 5)**

In this issue:

Review of Pruning Strategies for Chestnuts

by Ken Hunt, University of Missouri Center for Agroforestry

Author next to a 21-year old backyard tree ('Auburn Homestead ' Chinese Chestnut) that was slowly limbed up over many years.

Backyard Trees

Pruning for the homeowner backyard planting should be minimal. Pruning should start after the trees come into bearing, taking off a bottom limb or two a year until there is enough clearance for mowing and hand harvest. Once the trunk is developed, allow the tree to develop its natural spreading form. If a homeowner wants trees **(cont. page 3)**

A Message from the President

WCGA President
Harvey Correia
Correia Chestnut Farm
Isleton, Calif.

Greetings to all! I hope this growing season has finally settled down for at least most of you. This has been an unusual weather season for many of us in the west and I've pretty much learned to expect the unexpected this year.

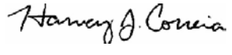
Many of you have orchards that are well into pollination and it's time to start thinking about collecting leaf samples for foliar analysis. While soil tests are important, it is not an indicator of what nutrients your trees are actually taking up. Foliar samples may help you adjust your orchard's nutrition program during the growing season. We'd appreciate receiving your foliar test results from healthy trees so that we can continue developing a database of what works well for chestnut growers. Please visit www.wcga.net/foliar.htm for additional details.

Ben and Sandy Bole have worked hard to organize this year's annual meeting and orchard tour it will have already been held by the time you receive this newsletter, so I hope I will have enjoyed seeing you all again. I also thank them for their dedication in organizing this important event. Your board has been working on some important matters, particularly a possible name change that will be voted on at our annual meeting. Some of you have provided input on items and this is appreciated very much. Please keep your thoughts and ideas coming into your board members.

This will be my last letter as your President and I wish to express my appreciation to the membership for allowing me to be of service to this fine association. I also wish to express my thanks to the rest of the board for their support. I also especially wish to express my thanks to our Newsletter Coordinator, Rachel McCoy, who has done an outstanding job in taking over this newsletter production. This can be a challenging task and I encourage all of you to see where you may be of help to your association and consider submitting newsletter articles. Rachel's contact information is located in the adjacent column.

All the best,

Harvey J. Correia



PUBLICATION DEADLINES
Fall issue deadline 9/15 mailed 10/15
Winter issue deadline 12/15 mailed 1/15
Spring issue deadline 3/15 mailed 4/15
Summer issue deadline 6/15 mailed 7/15

Review of pruning strategies for chestnuts (cont. from page 1)

to withstand wind and heavy crop loads then removal of branches with "narrow crotches" should occur during the first few years. These branches tend to have included bark in the crotch causing a weak branch with a tendency to split out at the crotch. Weak structured branches should be removed each spring during the first few years of tree growth to help develop strong scaffold branches along the trunk of the tree.

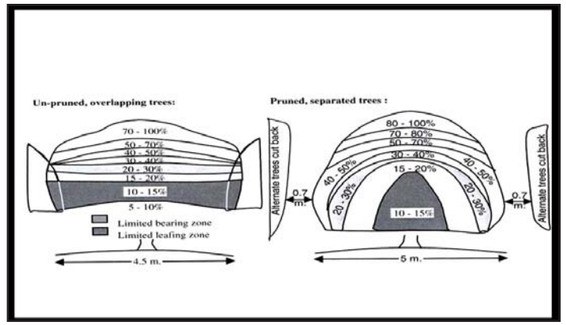


Figure 1: *Measurements of relative solar radiation within the tree canopy*

Low-Input Orchard

Larger plantings under medium intensity orchard culture (50-500 trees) should utilize the modified central-leader style training system used in the California walnut industry (Aldrich et al., 1982). Many cultivars do not naturally grow vertical central leaders. To ensure they do, a strong stake should be placed near each tree and a leader chosen and loosely tied to the stake. Central leaders grown vertically develop leaves and buds in a spiral fashion allowing good choices for scaffold branches growing in the correct direction. Central leaders allowed to bend over will develop buds on opposite sides of the shoot, not in a spiral fashion. The scaffold branches are selected during the second through sixth growing season, allowing for good spacing between branches in a spiral fashion along the main trunk. The height of the lowest scaffold branch depends on the individual growers equipment needs. Tree thinning will be required once crowding occurs in order to maintain high yields and uniform bearing throughout each tree. Crowded trees tend to create excessive shading on lower branches causing bearing only in the tops of the trees. Severe shading causes lower branches to die out and compromises general tree vigor (Vossen, 2000).

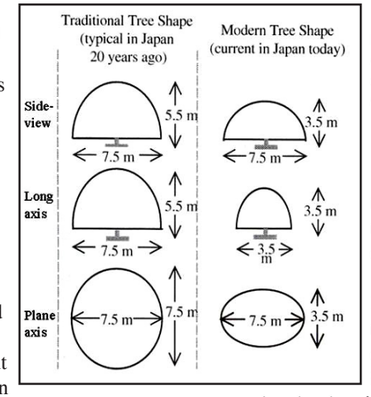


Figure 2: *(left) Re-shaping of chestnut trees in Japan.*

Intensively-Managed Orchard

A commercial grower (over 500 trees) needs to develop strategies to produce large quantities of high quality nuts per unit area. Currently many retail nuts are sold in-shell therefore a high percentage of large nuts is important. Three different pruning strategies will be reviewed that involve intensive pruning to contain the size of the tree which allows high planting densities and no need for tree removal.

Open Center pruning - Japan

An intensive level of culture has been developed in Japan and is now also being practiced in Australia and New Zealand providing a tight spacing within the row. Intensive culture allows for a shorter time frame to reach full production and possibly maximize nut production and nut size on a grower's acreage. Intensive pruning contains the size and shape of the trees so that tree thinning is not necessary (Araki, 1998; Bennett et al., 1999).

Dr. Hitoshi Araki developed the Japanese pruning system. The Japanese chestnut in Japan has similar tree form but perhaps a bit smaller than the Chinese chestnut. Small, densely planted chestnut orchards designed to maximize production from the limited land available characterize the pruning techniques designed in Japan. Initial planting densities of 13 by 13 feet and a final tree density of 13 by 26 is currently the Japanese industry standard. For use of typical farm machinery in Missouri, an initial density of 13 x 26 is recommended. Dr. Araki's research has shown that chestnuts require a relatively high level of light intensity to be able to set and develop fruit (Araki, 1998). He has shown a direct relationship between the intensity of sunlight within the tree canopy and the number of female flowers per cubic foot of canopy **(fig. 1)**.

He also correlated light intensity and the proportion of early flower drop, and determined that the diameter of bearing shoots was correlated to light intensity and the subsequent fruit size was directly related to bearing shoot diameter. Dr. Araki's pruning methods limit tree height to 12 - 13 feet and restrict the distance from the edge of the canopy to the center of the tree. To achieve this, an elliptical tree shape was adopted **(fig. 2)**

To achieve needed tree structure for the Japanese pruning method, pruning needs to start in the first year and continue regularly throughout the tree's life. The target initially should be to promote a leader and two main branches. The third year, the aim should be to encourage the tree to spread out **(fig. 3). (page 6)**

Thinning the inward growing branches is necessary to further encourage branch spreading into the alley. By approximately the 5th growing season, commercial cropping should begin. Cut out the central leader in the winter, leaving the two permanent branches that reach out into the alleyways, which become the permanent framework of the tree, and reducing tree height **(fig. 4). (cont. pg 6)**

Cultivar recommendations: middle California region

Choosing the right chestnut cultivars for your soil, climate and crop preferences requires experimentation over time and a sense of curiosity. Advice from fellow growers can also be helpful, and this section provides cultivar selections from the middle California region. If you have experience with cultivars you would like to share, we welcome your input. Please contact Michael Gold, editor, at goldm@missouri.edu or (573) 884-1448.

Cultivar Report, Owl Creek Ranch, Waterford, Calif. by Lucienne Grunder

The cultivars I have observed and evaluated over the last few years all grow at Owl Creek Ranch, about 100 miles due East of San Francisco, where the Sierra foothills just barely start rising.

The climate is Mediterranean, with virtually no rain from May to November. The annual rainfall adds up to about 16 inches. That means we have to "cheat" and add about 36 inches of irrigation water all through the summer months. We have some frost from December to February with temperatures not dipping below 25°F.

Most of our cultivars are European/Japanese hybrids, planted from E/J seeds in 1998, mostly from bags of Italian imported chestnuts of mixed parentage, Colossal and Marsol.

Over time we budded/grafted almost all of the seedlings to various cultivars. In the beginning the only easily obtainable grafting wood was Colossal. About 1/3 of the 9000 chestnut trees in the orchard are Colossal. I call them our bread and butter chestnuts; they produce well, and are mostly large and well liked.

And, there are many better tasting chestnuts ...

During the harvesting season we frequently have tastings, giving the nuts of various cultivars points for taste, ease of peeling, appearance and storage capability.

The table on page 8 summarizes our findings and represents averages for the last 3 years. The best performing cultivars in our orchard are the first 6 on the list. **(cont. page 8)**

Sweet Chestnuts

"The nut of this tree is hung high aloft, wrapped in a silk wrapper, which is enclosed in a case of sole leather, which again is packed in a mass of shock absorbing, vermin-proof pulp sealed up in a waterproof, iron-wood case, and finally cased in a vegetable porcupine of spines, almost impregnable. There is no nut so protected; there is no nut to compare with it as food."

Ernest Thompson Seton from The Library of Trees, 1917

Time for Foliar Analysis

Leaf analysis has been widely used for many years as a means of diagnosing and correcting nutrient disorders and for estimating fertilizer needs prior to the occurrence of nutrient disorders. It has been shown that leaf element content may be regarded as an index to the plant's nutritional status, which is related to growth and to crop production and quality. Leaf nutrient levels fall in the ranges of deficient, below normal, normal, above normal, and excess. These standard ranges have been established with fertilizer experiments in Oregon and elsewhere. Leaf nutrient levels, however, may vary throughout the season and from leaf to leaf on the plant, as well as from plant to plant in the field or orchard. The standards were developed to take these variables into consideration. Consequently, leaf sample values are valid only for leaves collected during the proper period, from the proper part of the plant, and handled in the standard fashion.

The results you receive from OSU are based on recommendations by Jeff Olsen, Extension Specialist for fruit trees and nuts in Yamhill County and are an attempt to give you an idea of your trees' needs.

WCGA members have been participating in foliar analysis since 2000 and sending their results to Jeff so that we may get a baseline for what's "normal" and desirable in chestnuts. Your participation will contribute to this study and benefit you in addition by providing information about your trees' nutrients needs.

Depending on where you live, mid-July to mid-August is the time to do the sampling. Samples from healthy, productive trees are to be used. Take 10 leaves from each of 5 trees randomly selected from all sides of each tree, only one leaf from a shoot. Collect leaves that are free of disease, dirt and/or damage. Pick leaves so that the petiole remains on the leaf.

Your analysis can be done by any of the following:

Central Analytical Laboratory
Plant Analysis
Dept. of Crop and Soil Science
Oregon State University
ALS 3079
Corvallis, OR 97331-7306
541-737-2187

Agri-Check, Inc.
Agricultural Testing Laboratory
PO Box 1350
Umatilla, OR 97882
800-537-1129 or 541-922-4894

Western Agricultural Laboratories
10220 SW Nimbus Ave.
Bldg. K9
Portland, OR 97223
503-968-9225

Whichever lab you choose to use, call them to get the kit they may require for shipping your samples. Make sure to send your results to **Jeff Olsen, 2050 Lafayette Ave., McMinnville, OR 97128.** *His phone is 503-434-7517 or 503-434-8915.*

The CALM storage method (cont. from page 1)

the safety margin under commercial storage conditions. It also involved testing different components for reliability and suitability under actual storage conditions and very importantly developing the best and most reliable sealing systems.

Since the controller units were to be used in coolrooms at -2°C to 2°C with water often on the floor, they all are designed to work with safe low voltage DC power. The first model **(Fig. 1)** involved the controller being stuck onto the plastic bag enclosing the nuts, the body of the oxygen sensor being in the controller box and the large plastic bag sealed by twisting the bag and using a cable tie. This was along the lines of the original concept which was meant to be a stick on atmosphere patch (SOAP) to control carbon dioxide levels. However, sealing and oxygen sensor problems meant this concept needed to be further refined. The second model **(Fig. 2)** involved moving the sensor well away from the heat of the electronics and placing it within the plastic bag. The sealing was done by tying the plastic around a soft sealant strip surrounding the extension tube containing the sensor. The sensor operation in this model was greatly improved, but the sealing method while reasonable once set up, proved difficult to use.

The third model (not shown) involved using a sealing plate attached to the plastic bag which was interfaced to the oxygen/carbon dioxide controller by an airtight pressure fit connection. The current model CALM V6 (CALM stands for Controlled Atmosphere LongLife Module) **(Fig. 3)** is similar to the third model. However, it has improved electronics and module design and works with lower power consumption. Further it has the sealing and plastic bag/tubing configured so that instead of storing 250 kg with one unit in a plastic bag inside a wooden storage bin, one can store 4 bins (up to 1.6 tons) of chestnuts with the bins of chestnuts enclosed within a plastic tube. This system is illustrated in **Figure 4 (page 9)** which shows several CALM units set up with four bins of chestnuts and running in a cool room.

Figure 1: The first model involved the controller being stuck onto the plastic bag enclosing the nuts, the body of the oxygen sensor being in the controller box and the large plastic bag sealed by twisting the bag and using a cable tie.

Parts of the CALM Storage System

Figure 5 (see page 9) illustrates the basic features of the CALM system. The various elements are (1) the plastic bag (tube) to cover the chestnuts, (2) Pallet Base under storage bin (to which

Figure 2: The second model involved moving the sensor well away from the heat of the electronics and placing it within the plastic bag.

Figure 3: Current CALM Model V6 sealed to chestnuts in plastic tube with interface plate.

tube is sealed), (3) cable tie to seal top of plastic bag, (4) CALM unit, (5) Interface Plate (to connect unit to plastic tube), (6) Oxygen Sensor, (7) flexible tubing to add and extract air to plastic tubing (8) rigid nylon tubing to deliver air to the chestnuts farthest from the CALM unit. Also included is a 12V DC plug pack (so that only safe 12V DC power cables will be on the cool room floor).

Each unit can be used to store 1 to 4 bins (400 to 1600 kg) of chestnuts. Basically the bins of chestnuts are placed on a pallet base which seals the bottoms of the bins, a plastic sleeve is placed over the bins and sealed at the pallet base with duct tape. A pallet bag interface is then attached to the plastic bag at the top of the first bin the CALM unit seals to the pallet bag interface with air oxygen sensor and tubing going through the interface to provide just enough fresh air to the chestnuts to maintain the ideal storage atmosphere. The CALM unit is powered by l2V DC power so that only safe low power cables are near the chestnut bins. Finally the top of the plastic bag is sealed with a cable tie. During storage operation the CALM system should be checked daily to ensure correct oxygen levels, power to units etc. **(cont. page 9)**

Pruning strategies for chestnuts (cont. from page 3)

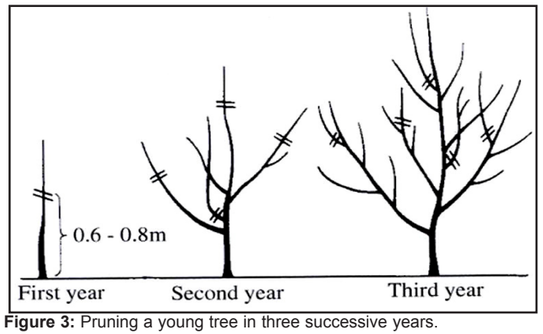


Figure 3: Pruning a young tree in three successive years.

The tree will fill the gaps left by removal of the central leader. From this point forward thin out interior branches as they begin to crowd, and also remove branches to maintain a reduced tree

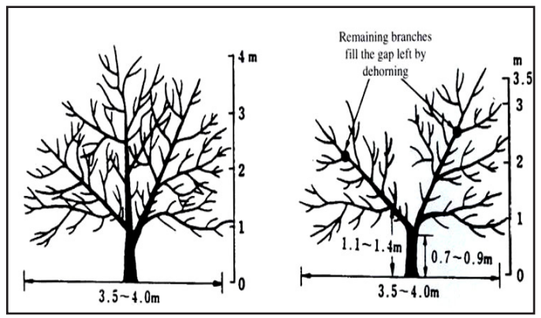


Figure 4: De-horning the central leader.

height and elliptical tree shape.

Depending on the cultivar and management inputs, time will determine whether close 13 x 26 foot spacing can be maintained in the Midwest. If not, every other tree will need to be removed to allow the necessary light penetration into the canopy. As mentioned, a Chinese chestnut production orchard has been established at the Univ. of Missouri, Horticulture and Agroforestry Center and at Kansas State (Wichita) to help determine the feasibility of the Japanese pruning method at 13 x 26 foot spacing, with the option of thinning to 26 x 26 if necessary.

The Japanese style of pruning has been introduced into the commercial chestnut industry in South Korea due to its efficiency for both fruit quality and cultural efficiency (**fig. 5**) (Kim, 2005).

Hedge row pruning – California

Biennial mechanized pruning (tree hedging) has been shown to be one method to reduce labor requirements and yet control tree size, sustain crop production, and improve nut quality.

An attractive alternative to hand pruning to maintain productivity of closely planted orchards is mechanized tree hedging. Experimental results have shown that once California walnut orchards become crowded, hedging to allow light between trees does not effectively alleviate the condition. Mechanical hedging, however, may be valuable in maintaining tree size and production of precocious lateral-bearing varieties where trees have not yet become crowded.

Figure 5: Japanese style pruning showing "low tree-form" in South Korea. Source: Kim 2005.

Hedgerow planting of lateral-bearing walnut cultivars is another method to increase early returns on investments and develop a more efficient high-density management system for walnuts. The trees are trained to produce a continual wall of foliage and nut-producing shoots in response to mechanical side hedging. The wall (not the single tree) becomes the management unit in the orchard. Higher early yields and the use of mechanized hedging machines for pruning are the major advantages. High initial cost is the primary disadvantage due to the increased number of trees/ha (Ramos et.al. 1997).

Hedgerow pruning is experimental in chestnut with two research programs exploring the feasibility, at the University of Trais-os-Montes and Alto Douro, Vila Real, Portugal (Gomes-Laranjo, et. al. 2004) and at the University of Missouri Horticulture and Agroforestry Research Center. Both studies have north-south rows to allow for the sun's movement to give equal amounts of radiation to the east and west facing sides of the pruned vegetative wall.

In **figure 6 (next page)**, trees are on a 10 x 10 meter grid with hedging performed on the east and west sides of the trees starting when the trees were in their 5th leaf. The first year of hedging, trees were pruned within 0.5 meter of the trunk, and the second year of hedging trees were pruned within 0.8 meter of the trunk to limit the shady and unproductive interior regions of the canopy. The trees at the Horticulture and Agroforestry Center at New Franklin, MO are on a 13 x 26 foot grid and are in their 5th leaf this coming spring, so will be pruned in a similar fashion to the Portugal research study starting this coming spring.

Preliminary results of the Portugal research show that leaf morphology, photosynthetic efficiency, and water relations in the interior part of the developing vegetative wall canopy are less affected by shading than conventionally pruned canopies, and that the trees have adapted well to intensive **(next)** pruning. The north-south orientation completely eliminates shady regions and reduces midday heat stress because neither side is fully irradiated.

Time will be needed to find out results on the effect this pruning system will have on the fruiting ability in these experimental orchards.

Author's Note: John Ireland, Research and Product Director of Fowler Nurseries in Newcastle, California has told me that a few of his clients are beginning to experiment with mechanical hedging in the Central Valley region with Colossal chestnut orchards. It would be very interesting to get to tour one of these orchards at one of our association's future meetings.

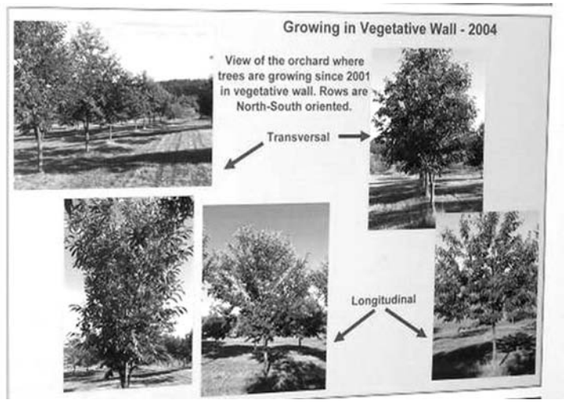


Figure 6: Example of European chestnut trees in their 9th leaf and with hedgerow style pruning in its 4th year in Portugal. (Poster from 2004 International Chestnut Congress)

Shoot renewal pruning – China

Greg Miller of Empire Chestnut Company near Carrollton, Ohio has observed intensely managed chestnut orchards in north-central China. Instead of tree removal as trees become crowded, they are instead contained in size by what Greg calls by "shoot renewal pruning" that is similar to what is done to blueberries **(fig. 7).**

Selected cultivars have been developed for this shoot renewal system that bear heavy crops of medium sized nuts with the texture and flavor that is favored for the roasted chestnut market. The orchard is heavily fertilized with nitrogen fertilizer to promote vegetative growth. **(Figure 8, next column)**

Figure 7. Older branches are removed after about 3-4 years of age (stub on right), then the next older branch is allowed to fruit (branch on left) while the "renewal" shoot is allowed to grow on the stubbed off branch. The branch on the left also has a "renewal" shoot developing for the future. The jagged stub on the left was an older branch that had been removed and the current fruiting branch was the previous "renewal" shoot.

Figure 8. A fifteen year old orchard where shoot renewal pruning is being practiced to contain the size of the trees. Sustenance crops are planted under the tree rows, such as beans and cereal grains, using a form of alley cropping.

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Vossen, P. 2000. Chestnut Culture in California. University of California-Davis, Division of Ag. and Nat. Resources, Publication 8010.

Cultivar Recommendations (cont. from page 4)

We have grafted, bare root trees of all the listed cultivars available during planting season as well as some of a yet un-named cultivar which seems to grow into a tree suitable for timber production. Growing chestnut trees for timber is a long range proposition which should very seriously be considered, in my view. (The best performing cultivars in our orchard are the first 6 in bold).

Cultivar	*Harvest*	*Nuts/lb*	*Marrone*	*Taste*	*Cross*	*Peel*	*Comment*
Bouche de Betizac	**9/5 - 9/20**	**15**	**y**	**v.good**	**E x J**	**v.easy**	**good for Central Valley**
Marrissard	**late**	**14-18**	**y**	**good**	**E x J**	**easy**	**good f.Central Valley, pollen sterile**
Precoce Migoule	**9/11 - 9/25**	**24-26**	**y**	**v.good**	**E x J**	**easy**	**pretty, striped nut**
Belle Epine	**med. - late**	**14-18**	**y**	**v.good**	**E**	**med**	**Marsol as pollenizer**
Marron du Var	**late**	**13-15**	**y**	**v.good**	**E x**	**easy**	**good storage**
Marrone di Susa	**very early**	**14-18**	**y**	**v.good**	**E**	**easy**	**candies well**
Colossal	9/6 - 9/26	14 -18	n	ok	E x J	fair	pollen sterile
Okei	2/26 - 10/10	13-15	n	good		fair	great pollenizer
Fowler	9/27 - 10/10	20-28	n	good	E x	easy	pollen sterile, sticks in burr on tree
Montesol	10/5 - 10/20	13-20	n	sweet	ExJxC?	easy	sizes irregular
Marsol	9/5 - 9/20	17-19	n	good	E x J	easy	makes good seedlings
Prolific	9/27 -10/10	15-18	n	fair	E x J	fair	some branches over produced, had sm.Nuts
Eurabella/ Silverleaf	early	18-22	n	v.good	JxPumila	easy	good pollenizer
Bisalta	mid-late	22-25	n	fair	E x J	fair	very fruitful
Marki	mid-late	22-25	n	v.good	E x J	easy	best storage

Celebrate National Chestnut Week, Oct. 9 - 15, 2005!!

Allen Creek Farm, Carolyn and Ray Young, Ridgefield, WA: The Youngs are hosting a Chestnut Festival on Oct. 9 from noon until 5:00. Demonstrations of harvesting and processing of fresh nuts and of the flour mill. Fresh and value-added products will be available for sale and samples of roasted nuts and a chestnut soup will be available for sampling. The garden maze will be open to everyone. Visit www.chestnutsonline.com for more information.

Chestnut Charlie's Organic Nuts, Charles NovoGradac, Lawrence, Kan: Chestnut Charlie is hosting a harvest tour of an organic nut and Christmas tree project, Sat. and Sun., Oct. 1-2, from 1-5 pm, in conjunction with the Lawrence, Kansas, area farm tour. Fresh Chinese and other chestnuts may be picked; sorting and sizing demonstrated; varieties compared; grafts demonstrated; guided tour of plantation and the packing facilities. For more information, visit www.chestnutcharlie.com. (Make it Chestnut Month - celebrate anytime in October!)

See more events on page 11!

Recipes Needed for Website!

The association's website is in the process of being updated with an eye toward gearing it to the consumer as well as to members. If you've surfed any food websites recently you will notice that most of them have recipes that make you want to try that particular food. That's what we'd like to accomplish with the WCGA site, but we need your help.

Sandy Bole, our resident gourmet cook, is willing to compile this section for us and make sure that what we publish are the best of the best – the kinds of recipes that will make our customers want more.

Your job is to come up with recipes. Each member is asked to send Sandy at least 2 of your favorite chestnut recipes no later than July 31. You can email them to her at **sbole@aol.com** or send them via snail mail to 15500 SW Roberts Rd., Sherwood, OR 97140. Her phone is 503-625-1248, and fax is 503-625-1937.

The CALM storage method (cont. from page 5)

Figure 4: Several CALM Units running showing the bins of chestnuts in plastic tube and sealed to pallet base.

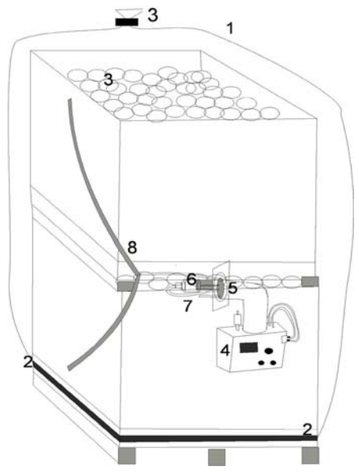

Figure 5 (left): Parts of the CALM System.

The Benefits of the CALM System

The CALM system, largely through maintaining a constant high carbon dioxide atmosphere around the chestnuts, greatly reduces rots especially external rots. This is seen in **Figure 6 (next column)**, where after six months storage the CALM system has essentially maintained mold or rot levels at those initially found. There is a slight, but not significant improvement by also using sanitizers or fungicides. This excellent control of external rots was consistently observed. Internal rot levels were very low in these experiments and consequently there was usually no effect of the CALM system. However, in one experiment there was significant levels of internal rot and it was possible to demonstrate significant control of internal rots by the CALM units. This control of internal rots is shown in **Figure 7 (next column)**.

The oxygen levels within the CALM system fluctuate within a range of values determined by setup of the CALM system and the volume of air within the system. The variation in oxygen levels for a CALM Model three unit is shown in Figure 7. The current unit runs within a much smaller range, typically from 4 to 4.5% oxygen.

Conclusion

Several years of research has shown that the CALM system combined with careful preparation of the chestnuts prior to storage gives excellent extension of storage life. The main benefit is on reduction of external mold on the soft hilum. The long term costs of operating the CALM unit will only be precisely known after several years experience. However, based on current experience, one could estimate on the CALM unit lasting about 6-9 years (including the pallet base and interface plate), the oxygen sensor, air pump and DC power supply needing replacing every two to three years and the plastic bag replacing every one to two years. Based on these estimates and current prices, the cost of storing with this system would be about $150 to $250 per year to greatly reduce external and internal rots and greatly extend the storage life up to 8 to 10 months if required. For a stack of one ton, CALM storage costs are estimated at 15 to 25 cents per kilogram. Besides this amount, the only costs to the farmer are a few dollars of electricity, a short time to set up the bins and regular (preferably daily) checks during storage to ensure the units are connected to power and working normally.

(N.B. Royalties from the sale of each of these units goes to CGA and HAL as a continual return on their research investment)

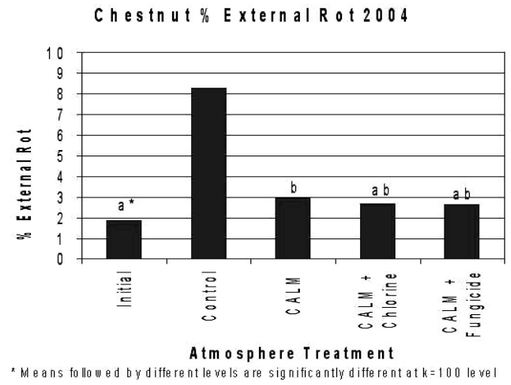

Figure 6 (above): Control of external rots by the CALM system.

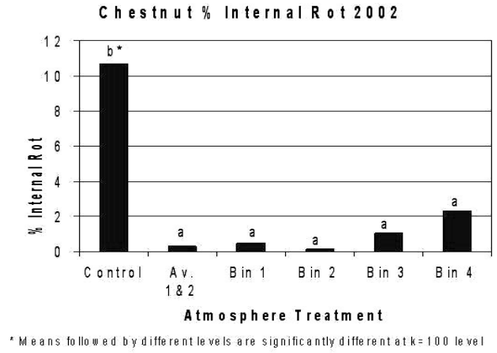

Figure 7: Control of internal rots by CALM system Model 2.

Chestnut sabbatical to Italy gives Michigan State professor new inspiration: A travel log, part 2

Dennis Fulbright, professor of Plant Pathology, Michigan State University, recently completed a five month chestnut research sabbatical to Italy. He shares his experiences in this chestnut-oriented culture in this "travel log" article, including information about the integration of the nut into local foods and festivals and cultivation and production challenges.

Don't miss part 3 of the story in the Oct. Western Chestnut issue!

About a week after we arrived, we were taken to the Alpine research center in Pieve Tesino in the foothills of the Alps about an hour outside of Trento where Andrea was teaching a field mycology course (mostly mushrooms). Everyday for a week we went mushroom collecting in the hills filling baskets and for me, re-learning how to identify and classify them. We ate most of the mushrooms collected and every night, for a week, Andrea's students took turns fixing dinner for the staff, Jane and me. At the end of the week, on Saturday we went hiking to the 9,000-foot peak called Cimi d'Asta. Andrea and I frequently stopped and held up the walk photographing and discussing diseases of the trees along the path; spruce and fir rusts, armillaria root rot, known and unknown canker diseases and many more.

Officially, I had come to Italy to learn more about chestnut, including chestnut culture, chestnut processing and marketing and chestnut blight. Anything I learned about chestnut nut diseases, insects and other pests of chestnut would be icing on the cake. I was also interested in other tree diseases especially Phytophthora root rot and the identification of Phytophthora isolates. Andrea had done a lot of work on the native oak forests in Italy and the causes of their slow and steady decline. There was a lot to do and see in a short 5 months. Not too long after coming back to Viterbo from the Alps, we returned to them, passing through them on our way to a conference in Freising, Germany near Munich. I also had the opportunity to visit the field sites where Andrea is screening observing the progress of Phytophthora root rot as it kills 200-year-old chestnut trees on the sides of hills and mountains. He is using very sophisticated technology on the mountainsides and in the air in fly-bys over these ancient forests. One comment he told me before I came home was that he had data suggesting a perfect correlation between the number of roads on the mountains and the amount of Phytophthora root rot; the more roads on a hillside the more Phythopthora infections could be found there. It was sad seeing trees that had fought off chestnut blight succumb to the strangulation of Phytophthora cambiovora. When the trees die from root rot, no sprouts appear so the hillside looks rather bare until new vegetation begins to grow.

Viterbo is about 60 miles north of Rome. It is near the Cimini Mountains, the rim of an extinct volcano. The small range of hills has an elevation as high as 3,000 feet and has its own climate. It can be foggy up on the hill and it can even snow. Our flat was in the medieval quarter of the town of about 100,00 people, which appears as it did in the 1200's. As far as we could see were ancient buildings, the defensive wall or landscapes sloping to the Mediterranean Sea in the distance.

The local Cimini Mountains are home to beech, oak, chestnut and hazelnut forests and many of the chestnut and hazelnut forests function as orchards. A hillside covered with chestnut can be utilized in two ways and almost always is. One way is to let the wild *Castanea sativa* (European chestnut) trees grow for about 17 years and then cut them down and use them as rot resistant poles, much like we, in the states, use pressure treated lumber. The poles are used as fence posts, utility poles and terracing. Small wood mills cut the trees, which may attain 10 to 12 inch diameters during this 17-year growth period. After the previous clear cut, the stumps are allowed to send up new sprouts. These are managed until, at some point, all but three sprouts are eliminated and the three stems per stump are left to grow. With a well-established, large root system pushing them, the remaining three stems grow fast and straight. *More to come in the fall issue!*

The back of our flat in Viterbo with laundry out drying.

Typical orchard where old stumps are allowed to sprout. The sprout is grafted to maronni variety.

Celebrate National Chestnut Week, Oct. 9 - 15, 2005!

3rd Annual Missouri Chestnut Roast, Oct. 29, University of Missouri Center for Agroforestry HARC Farm, New Franklin, Mo: The Chestnut Roast is an outreach and educational opportunity featuring guided farm tours of the 660-acre HARC farm, agricultural exhibits and displays, free samples of fresh Missouri roasted chestnuts and chestnut dishes, agroforestry and nut cooking demonstrations, a children's tent and several Missouri value-added food vendors, featuring Missouri black walnuts, chestnuts and pecans; meats and cheeses; specialty condiments and wines. Free admission and free parking. Hours are 10 a.m. to 4 p.m. Visit www.centerforagroforestry.org for more information.

Cadillac, Michigan Chestnut Festival: Oct. 15, Cadillac, Mich. 10 a.m. - 4 p.m. Free roasted chestnuts and chestnut soup, chestnut gifts and other chestnut foodstuffs available. Fresh chestnuts. For more information, contact Dennis Fulbright, Michigan State University, at fulbrig1@mail.msu.edu.

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