Chestnut Growers of America

The Chestnut Grower

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Post-Harvest Quality of Chestnuts: A Challenge for Growers

By Gregory Miller, Empire Chestnut Company, Ohio

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The quality of chestnuts when purchased by consumers is quite variable and often disappointing. One of the pre-requisites for expanding the chestnut industry is to maintain good quality control from grower to consumer.

Maintaining quality control from the grower to the consumer is, as Miller writes, a "pre-requisite for expanding the chestnut industry."

There are two major components of 'quality', namely characteristics and condition. Characteristics are primarily genetically determined, while condition results from pre- and post-harvest treatment. From a practical standpoint, the distinction between characteristics and condition can be thought of as cultivar vs. care. Of the two, cultivar is probably the more important. As is the case with most fruit trees, there is considerable genetic variation in quality characteristics. So, the most important step in maintaining post-harvest quality is the preplanting choice of cultivars (or seedlings). Once the trees are planted, though, there remains the ongoing task of getting the chestnuts from tree to consumer in good condition. The care required to deliver chestnuts in good condition is the primary focus of this discussion.

To understand their proper care, it is useful to consider the unique attributes of chestnuts as a produce **(cont. pg 3)**

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State of the Crop: Update from Growers Across the Nation

In this article, growers from across the nation were asked to give a preview of their crop, and address any challenges or unique situations they have encountered.

Tom Wahl
Red Fern Farm
Wapello, Iowa

"It looked like a repeat of last year, for a while--we had hot weather in early April which caused the chestnuts to leaf out early, then we had a frost in late April which scorched the newly emerged leaves--but we didn't get the hard, killing freeze like last year, and everything recovered. It looks now like the trees are trying to make up for having no crop last year by having a double crop this year. If we manage to get some rain, I think we will have a bumper crop. We are still in drought--our sixth year, now--but not quite as bad as last year, and I have hopes for a good year. It's really too early to tell just yet. The female flowers are just starting to appear, and no pollen shed yet, **(cont. pg 5)**

A Message from the President

Hill Craddock,
Associate professor
Univ. of Tennessee
Dept. of biological and Environmental sciences

Over the life of the orchard, the choice of the proper cultivar may be the single most important decision faced by the chestnut grower. Cultivar choice has long-term consequences, because the productive life of a chestnut tree can range from 25 years for the Japanese chestnut to over 100 years for the European species. For commercial growers, choices may be limited to what is available in the nursery trade -- which may or may not be the best possible cultivars for a given situation.

A few years back, a colleague of mine walked into my office and told me he wanted to grow chestnuts commercially (of course I tried to talk him out of it). But he had really done his homework and was sure that chestnut was the crop he needed to diversify his family farm. He just wanted me to tell him which cultivars to plant: "What is the best chestnut cultivar for commercial chestnut production in southeastern Tennessee?" he asked. Well, I didn't know how to answer. I made a mental list of the old standards ('Nanking,' 'Crane'), a couple hybrids ('Sleeping Giant,' 'Eaton'), the Dunstan hybrids, and 'Colossal.' I proposed to him a cultivar trial. The idea was to test as many of the commercially available chestnut cultivars as we could get our hands on in a fully replicated experimental design. We consulted nurserymen, growers, University professors and chestnut enthusiasts. Everyone had an opinion about the best chestnut, but there were no clear winners. Eventually we settled on twenty types we thought would grow well and produce in our climate. Some of the varieties were readily available; others we needed to propagate ourselves. To the original twenty, we have since added another thirty or so. The results are encouraging. I think we can grow chestnuts in Tennessee, and I think that among the varieties on trial here, there are some pretty good cultivars. But I still don't know what the best cultivar is.

There are few data available for comparing performances of different chestnut clones, and those data may be from very different environments. So, it is of great importance that we continue to collect and grow chestnut cultivars in trial orchards throughout the US. The trial in Chattanooga is but one example. Larger and older trials are underway in Missouri and Michigan, and many smaller plantings have been made. Recent introductions of chestnut material from Europe and Asia complement the diversity of germplasm here. Breeding and selection may eventually lead to new introductions improving upon the nut quality and disease resistance of today's best cultivars. As for every commercial fruit and nut crop, chestnut cultivars are propagated clonally, usually by grafting, so the introduction of new cultivars may require many years of testing and multiplication. Cultivar choice is one of the most important challenges to our industry, but soon we will have real data to provide to our growers about which types of chestnut really will grow and produce well in each chestnut-growing region. I am confident that in 25, and 100 years from now, the Chestnut Growers of America will be glad we made good choices.

Hill

NOTICE
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Post-Harvest Quality of Chestnuts (cont. from page 1)

item. In some respects they are like fruits or vegetables, in some respects like nuts, and in some respects like grains. At harvest time, chestnuts are living, respiring seeds, composed of about 50% water, 40% carbohydrates (mostly starch), and the balance protein, fats, other organics and minerals. Morphologically, the kernel is an embryo consisting of two large cotyledons attached to a small, but easily visible embryonic plant. The kernel is surrounded by a fuzzy, papery cover called the pellicle which is actually the seed coat (testa). Outside the pellicle is a brown, leathery shell, which is actually the fruit. The chestnut is designed to overwinter at or beneath the soil surface and germinate in the spring. Consequently, it has a chilling requirement. In contrast to most other seeds, chestnuts lose viability if they dry much below 35% moisture. Proper storage of fresh chestnuts essentially involves mimicking the conditions they would encounter in their natural environment, that is, keep them cool, moist and eat them before they germinate.

Pre-harvest care

Post-harvest condition begins as the crop develops on the tree. Before harvest, chestnuts are subject to several maladies, including shell splitting, fungal attack, insect attack (esp. chestnut weevils), and physiological breakdown. Crop load, nut size and kernel quality are undoubtedly affected by grower-controlled inputs such as mineral nutrition and soil moisture, but there hasn't been much research on these subjects. In lieu of good research data, we do not have observations and experience that may be useful to growers, and certainly suggest experiments that ought to be performed.

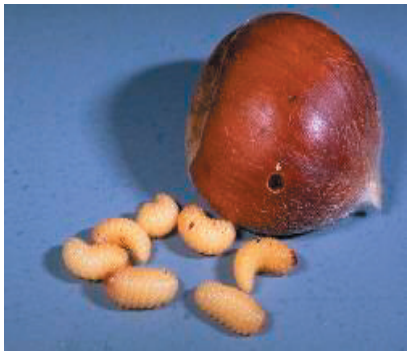
Early season growing conditions affect flower bud formation which translates into next year's crop load. Late season growing conditions, especially soil moisture, affect nut size. Since half of the kernel growth occurs during the last two weeks before ripening, moisture is critical during this period. During this rapid kernel growth period the shells sometimes split at the stylar end (pointy end). Chestnuts with split shells usually mould and must be culled. Shell splitting is greatly influenced by cultivar and probably pollinizer, but it also seems to be exacerbated by excessive moisture just before ripening. It appears that normally the shell stops growing before the kernel is completely filled. If the kernel gets too big, it bursts the shell. On the other hand, if the kernel doesn't get big enough (this happens) the result is unsightly, wrinkled chestnuts. Although experimental data are lacking, I suspect that proper timing and amount of irrigation will minimize both shell splitting and under-filling, while at the same time, maximize nut size.

Since most kernel growth occurs just before ripening, it is important that the crop is not harvested prematurely. If chestnuts are harvested just one week before they would normally drop, they may be difficult to remove from the burrs and may be detectably smaller and softer in texture. If they are harvested two weeks early, they surely will be difficult to remove from the burrs and be obviously small, shriveled and soft – essentially unmarketable. Chestnuts should not be picked or shaken from the tree until the burrs begin to split ('smile', as we all call it), revealing brown-colored chestnuts. The highest quality and yield result from promptly harvesting naturally fallen chestnuts.

While they are still on the tree, chestnuts are subject to three types of fungal attack, namely, blossom end rot, kernel spotting, and soft rot. Blossom end rot first shows up as a brown spot on the stylar end of the burr before ripening. At harvest, the stylar end of the chestnut is dark-colored and the tip of the kernel is decayed. Frequently, chestnuts with split shells also exhibit stylar end decay. As with shell splitting, blossom end rot seems to be very season dependent and cultivar dependent. There are no recommendations for chemical control, the best control is selection of resistant cultivars.

At harvest time, a low percentage of chestnuts (ca. 5%) will exhibit small, brown spots on the kernel surfaces. These are visible only when the chestnuts are peeled. Examination with a dissecting microscope or hand lens reveals that these spots are small fungal infections. These small spots may or may not develop into more extensive decay, but even before decay becomes extensive, they impart slight off-flavors to the kernel. There are no control recommendations, but it should be realized that no post-harvest treatments or sanitation can 'prevent' this kernel spotting which has occurred while the nuts are still on the tree.

At or shortly after harvest, some chestnuts exhibit a soft rot which may give the shell a dark or water-soaked appearance. The real test, though, is to squeeze the nut. Sound chestnuts are very firm and do not yield to finger pressure. If the chestnut is soft or mushy, it is a soft rot victim. If it is cut open (or it bursts when squeezed), it will look like mashed potatoes, have a fermented smell, and be inedible. The causes and control are not well understood, but soft rot seems more common under conditions of excessive moisture and excessive nitrogen fertilization.



Chestnut weevils (*Curculio* spp.) are serious pests in all the native chestnut production regions of the world. Eggs are **(cont pg. 6)**

How We Bring 4,000 People to our Chestnut Orchards - And You Can, Too!

By Rachel McCoy, University of Missouri Center for Agroforestry

Now is the time to think about how you will get your chestnuts from point A to point B – from your farm to your customers' homes. The exciting part of considering this process is realizing that a great deal of the work in connecting your product to your consumers can be achieved for free. After all, National Chestnut Week (like the Great Pumpkin) only comes once a year. Don't miss it! ***(Sunday, Oct. 8 - Saturday Oct. 14)***

Here at the Center for Agroforestry, our annual Missouri Chestnut Roast is proof that even free public relations activities can result in a tremendous response – last year, a record crowd of more than 4,000 guests joined us at the farm, with attendance increasing each year since the festival began.

It is vital to establish a relationship with your local media. You grow chestnuts. Not very many farmers do. The media will want to feature your farm on the local television and/or radio networks, if your story is presented in the right words at the right time - and especially, if they *know* you.

One method is to develop a regular schedule of sending press releases to your local media. Challenge yourself every few months to jot down a few ideas about what's happening on your farm to turn into a news release – chestnut harvest, of course, is the "biggee." This consistent feed of content to your local media will add up over time, forming a positive impression of your operation in the news directors' minds. This can pay off big!

A list of your local media will be very helpful. To prepare a media list, check the internet and the phone book. You may want to consider joining your local chamber of commerce; they may have a list to share with you. Store this list in your computer for easy updates and changes. Media outlets within 50-60 miles should be considered. (After all, you grow chestnuts. You're worth the drive.) Each time you make contact with a media outlet, record it in a table or spreadsheet. List who you talked to, what day, and any specific details of the conversation. You can use this information to make follow-up calls later, closer to your National Chestnut Week event.

Come up with your own personal attention-grabber. What is special and interesting about your farm that people should know? Even better, develop a tagline or slogan for your farm. Use this every time you send out a media release, across the top (or the bottom, as a footer). This is an important component of the brand recognition process.

Hit the ground running. Your headline and first paragraph are the most important parts of a media release. Try beginning your story with a catchy, one-line paragraph. Then follow up with the details in the second paragraph, making sure to paint a mental picture.

So what are some examples of attention-grabbers?

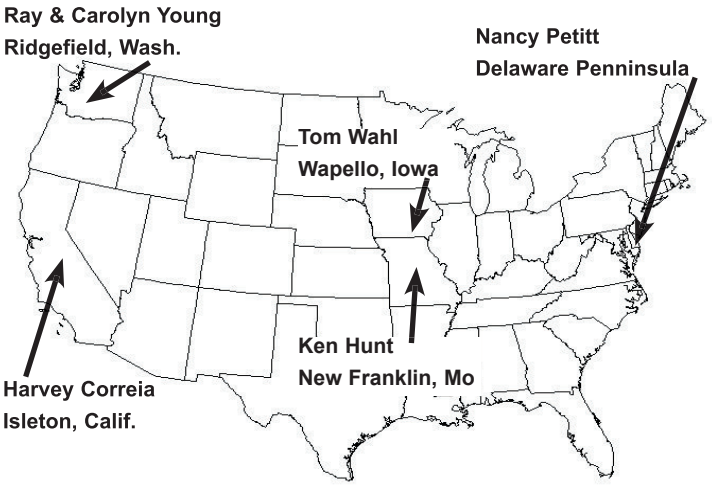
- A local service club is working at your harvest or retail business to earn money for their cause (during National Chestnut Week, of course)
- You are donating a portion of your crop to a local food bank (hey, and it's National Chestnut week, too)
- You are inviting youth to come and participate in the chestnut harvest activities (during National Chestnut Week, go figure!)
- You are hosting a chef demonstration or cook-off with chestnuts (and it's National … Ok, you get the picture)
- You're giving away a special chestnut dinner for two to lucky winning visitors
- You have raised the world's largest chestnut, weighing in at just under 200 pounds. (Better get started on that paper machē now.) Actually, hundreds of visitors come to Brunswick, Mo., each year to have their picture taken with the "World's Largest Pecan," a unique and popular sculpture. Strange, but it works.

Once you've written your attention-grabbing media release, send the media outlets (or even better, deliver in person) a special goodie basket two weeks before National Chestnut Week. This would contain chestnut products, a map to your location with contact information, a media release about your National Chestnut Week activities. Don't try to capture their attention one week before National Chestnut Week, get on the schedule two to three weeks early so they (and you) will have time to prepare. The media kit we use for promoting the Chestnut Roast contains a t-shirt, assorted chestnut goodies, even a specialized "media" badge to wear on their farm visit. The badge makes them feel special and important **(cont. pg 9)**

State of the Crop: Growers' Update (cont. from page 1)

but it looks pretty good so far. Not much to add--we have lots of female flowers, the most I have ever seen, but we are still waiting for the rain. The top few inches have adequate moisture for the time being, but nothing in the subsoil, making us very vulnerable to a prolonged dry spell. We won't really know for sure until October."

Ken Hunt, Post-Doctoral Fellow
University of Missouri Center for Agroforestry
New Franklin, Mo.



"At this time, the 2006 nut crop looks to be good to excellent. Flowering is over, and there seems to be a good number of female burs on most cultivars. Moisture is adequate so far, though subsoil moisture is somewhat shy -- but all trees can be drip irrigated. Last year's overall nut yield was 4,000 pounds and I estimate we'll see at least 5,000 pounds this year, mainly due to the trees being one year larger. We have been spraying one time for potato leaf hopper each spring, which stops the leaf curl and cupping in its tracks. This year's spray result was that potato leaf hopper damage was limited to around 6 leaves, with the all new growth after spraying looking normal."

Ray and Carolyn Young
Allen Creek Farm
Ridgefield, Wash.

"It looks like it will be a good year. Trees look very full with lots of catkins. No dieback this year. We anticipate a large crop.

We see no evidence of any problems, including shothole borer, frost damage, sunscald, etc. Our biggest problem is a lack of available labor and having a $7.63/hour minimum wage – the highest in the nation!!

Those who do foliar analysis, including ourselves, don't do it until the recommended time for this area -- mid-July. If we send it to Oregon State University, which seems to have the most complete analysis, it takes 4-6 weeks to get the results. We'd like to encourage growers to do the analysis, as it would be a great help to them and would also help to define the baseline we all need. Results should be sent to Jeff Olsen, Extension Agent at OSU, and he will coordinate them. Contact information: Jeff Olsen, OSU Extension Horticulturalist, Yamhill County Extension, 2050 Lafayette Ave., McMinnville, OR, 97128-9333 Ph. 503-434-8915.

Nancy Petitt
Delmarvelous Chestnuts
Delmarva Penninsula, Del.

"Our crop looks fabulous. We began to see nuts around Memorial Day, and we already have mature pollen. The orchard smells great. The nut set looks heavy. Though the east coast has been in a drought all spring, we have had nice rain during the last week or so, but we're still in a drought. A bigger crop is expected this year than last. It depends on our media coverage, but each year we hope to have nuts in December for sale, and each year we run out around Halloween. People have learned to place orders early.

Our recent media coverage is Hunt magazine, possibly the most upscale piece we've done. This is a regional magazine for people who have foxes and hunting interests. The article shows recipes and our product, and the coverage came through local press. A photographer here started a project called the Face of Farming, showing pictures of grain, vegetable and horse farmers, including our picture. The pictures were on display at the agricultural museum here, and have traveled on since then. The Hunt magazine people saw the exhibit, remembered they had seen us on Food TV, and then called us for the story. Do something local, someone sees it, and then you get something else – that's the way publicity has worked for us." **(cont. pg 11)**

National Chestnut Week!

Oct. 8 - Oct. 14, 2006

Make plans now to recruit the media to your orchard events. Together we can continue building the chestnut industry.

Post-Harvest Chestnut Quality (cont. from pg 3)

laid shortly before harvest in the kernels through tiny holes drilled in the shells. The eggs hatch into cream-colored grubs which grow and tunnel through the chestnut kernels until they emerge. The unexpected discovery of live chestnut weevils, either before or after emergence, usually elicits a response ranging from disgust to hysteria. In other words, most consumers have zero tolerance for wormy chestnuts. Even though chestnut weevils are generally unknown in the Pacific Northwest, they are established in a few places in California. It is a pest that all West Coast growers should be aware of and prepared to take measures against. They can be controlled with insecticides (assuming a label for this use), or with a post-harvest hot water dip (50ºC for 10 minutes). It is difficult to identify weevil-infested chestnuts before emergence, which may take two or more weeks.

Such benign-looking chestnuts may not reveal their secret residents until after they leave the grower. Special care should be exercised in the handling and transport of all potentially infested chestnuts, especially seed nuts. Another problem exhibited by chestnuts at harvest time is a 'brown kernel' condition that appears to be some sort of internal physiological breakdown. When the affected chestnut is cut open, the interior of the cotyledon tissue exhibits some degree of browning and disintegration, somewhat resembling bitter pit of apples. Brown kernel chestnuts have a somewhat soft texture and bitter flavor that renders them inedible. There is no evidence of fungal invasion and they are distinctly different than the soft-rotted chestnuts described previously. The brown kernel breakdown is especially prevalent in Japanese chestnuts and Euro-Japanese hybrids, but does occur in other species as well. It seldom affects all the nuts on a tree and the cut open kernels can easily be classified as either brown or normal with no gradient in between. It seems to be under strong genetic influence and the best control is to plant cultivars which don't exhibit this characteristic. Based on experience with physiological breakdown in other crops, mineral nutrition may have an influence. However, nutrition alone doesn't easily explain the usual occurrence of both normal and brown kernels on the same tree.

Post-harvest care

After chestnuts ripen, there begins a sequence of handling, movement, treatments, and storage that should end with pleasant consumption, but too often does not. The pleasant consumption ending requires proper care at every step from tree to mouth. The durable shell often betrays the condition of the enclosed kernel and gives the mistaken impression that chestnuts are indestructible. Most important, though, is the dilemma that chestnuts which are in good condition for storage are not in good condition for eating, and those which are in good condition for eating are not in good condition for storage. The situation is analogous to that for pears or bananas except that instead of ripening, chestnuts undergo a drying process called 'curing'. During or after curing, chestnuts often become moldy. In order to store and cure chestnuts without molding, we need to understand post-harvest physiology.

At the time of ripening, chestnuts are about 50% water. The fact that they do not quickly mould indicates that living chestnut kernel tissue has some ability to resist fungal invasion, just as living fruits and vegetables do. There is considerable evidence for this 'live kernel resistance', but little is known of how it works. As soon as they ripen, chestnuts usually begin to lose moisture, especially if the weather is warm and dry. If the moisture content drops from 50% to about 35% (which can occur in as little as one or two days), chestnuts lose the ability to subsequently germinate. In other words, when seed viability is lost, live kernel resistance is lost. Once the kernels dry to a point below the viability threshold, viability cannot be restored by rehydration. If chestnuts are to be stored fresh, they must not be allowed to dry below 35% moisture (the point at which the kernel just begins to shrink away from the shell). Storage life can be enhanced by rehydration (soaking) and maintenance of very high humidity, even allowing free moisture on the nuts.

For maximum storage life and seed viability, the grower should promptly harvest the crop before any drying has occurred. It is better to get the chestnuts into storage before they dry than it is to rehydrate them. The time period between maturation and nut drop is in the range of three to seven days; shorter under warm conditions, longer under cool conditions. The nuts on a given tree do not all mature at the same time. If the tree is to be harvested by a shake and catch method, there is a very short window when this may be done. If the chestnuts are to be harvested from the ground after they naturally fall, it may be necessary to harvest under each tree several times to prevent the nuts on the ground from drying. If the chestnuts are allowed to accumulate on the ground for several days before harvest, the orchard floor should be moist and the weather should not be hot and dry. Cool, rainy weather during nut drop is ideal, at least for maintenance of nut storability. Contrary to popular belief, neither ground contact nor free moisture 'contaminates' chestnuts – the culprit is excessive drying.

After chestnuts are removed from the field, they must be cleaned, perhaps stored, graded, packed, and delivered to the buyer. Cleaning may be accomplished by screening and fanning. Brushing or washing may also be employed. Fresh, sound chestnuts are slightly denser than water, i.e. they sink. During the handling from harvest through cleaning, measures should be taken to maintain or increase the kernel moisture content. In Europe, the traditional handling

method begins by soaking the chestnuts in water for seven to nine days. Alternatively, the chestnuts are placed in hot (50ºC) water for 30 to 45 minutes, followed by quenching in cold water. The purposes of these water treatments are to rehydrate the kernels, kill weevils, and reduce mould losses. The reduction in molding may be attributed to rehydration, direct killing of spoilage fungi, or encouragement of antagonistic micro-organisms (e.g. yeasts). After the water treatments, the chestnuts are carefully and slowly dried just until the shell surfaces are dry. These soaking treatments change the flavour of the kernel. Specifically, the chestnuts acquire a fermented flavour (anaerobic respiration products) and bitter flavour (presumably tannins leached from the shell). These off-flavours diminish with time (several days to several weeks), but the soaking treatments are not good for chestnuts which are to be consumed immediately. To avoid the off-flavours, I recommend a 'lighter' soaking regime. Chestnuts awaiting cleaning are kept moist by spraying. Then, we use a 30 minute hot water treatment (mainly for weevil control) without cold water quenching. The hot water should be maintained at ca. 200 ppm hypochlorite (e.g. Clorox) to oxidize tannins. Nuts to be used for seed are then soaked for a week, but those destined for consumption are not.

After water treatment the chestnuts should be allowed to 'rest' for three or four days before grading. They should be rested in a cool, shady area (preferably in a building) where there is enough air circulation that they do not heat, but not so much air movement that they dry. We rest chestnuts in 50 lb mesh bags lying on the concrete floor, just one bag deep (don't pile them). During the rest period, most of the free moisture will disappear from the shells and any moldy or soft rotted chestnuts will become covered with fungal hyphae, making them much easier to identify and cull out. While it appears that some chestnuts become moldy during this period, what really happens is that already moldy chestnuts make themselves known. Any chestnuts that appear questionable should be squeezed. If they're soft, discard; if they're firm, keep. This is also the time to size the chestnuts, if necessary. Chestnuts don't have an axis of symmetry; they don't roll very well; and they quickly plug a screen. In other words, sizing requires some ingenuity, but it can be done. If everything has been done properly up to this point, the 'good' chestnuts should be glossy, firm and attractive. At this point, such chestnuts can be put into storage or packed and sold. On the other hand, if the chestnut shells have a dull finish and the kernels have begun to shrink inside the shell, the chestnuts have begun **(next)**

Post-Harvest Chestnut Quality (cont.)

to cure. They are difficult to store, but good to eat. Such partly cured chestnuts should be used within two or three weeks.

Chestnuts which are glossy and firm, i.e. fully hydrated, are relatively easy to store and ship. As long as they remain in this hydrated condition, they won't easily mould. For long-term storage (four weeks or more), they should be kept cool and moist with ample air circulation through the nuts. It should be remembered that properly stored chestnuts will begin to germinate in cold storage in late January or February (mid to late winter). They should not be stored in deep bulk piles or large bags. Fungal and chestnut metabolism generates heat which causes water to evaporate and migrate; this leads to fungal decay. Although the best storage temperature is slightly below 0ºC, fresh chestnuts must not be allowed to freeze. Frozen chestnuts are killed and about as useful as frozen apples, i.e. they quickly deteriorate after thawing. The freezing point of fresh chestnuts is dependent on moisture and sugar contents, which change during storage, but is lower than –3ºC. Before freezing, chestnuts will supercool several degrees below their freezing point. Chestnuts should be shipped in some 'breathable' container such as woven poly, burlap, or mesh bags. The relatively tight woven poly bags should not be used if the chestnuts will spend much time at warm temperatures (>20ºC), but work fine if kept cool. One of the problems encountered in shipping chestnuts is they lose moisture, i.e. they lose weight. There needs to be an understanding regarding who is paying for this weight loss.

There are numerous species of spoilage fungi which can attack chestnuts. We most commonly see cool temperature fungi e.g. Penicillium spp and Fusarium spp. Fungal infection ranges in severity from a few dark spots on the kernel surface to complete decay of the kernel. These fungi produce mycotoxins which pose some health risk. Mouldy chestnut samples were found to contain tremogens, zearalenone, T-2 toxin, vomitoxin, and fumonisin B1. These toxins are not currently regulated in the USA, but they are regulated in some other countries. Our chestnut samples were never found to contain aflatoxin, probably because aflatoxin is produced under warm conditions. The above-mentioned toxins were generally detected at low levels, and only in very moldy chestnut kernels. Slightly decayed kernels, i.e. brown-spotted kernels, did not contain detectable mycotoxins. From a product quality standpoint, fungal decay causes two concerns; off-flavours and mycotoxins. Off-flavours can be detected even in slightly moldy chestnuts, before there is any significant mycotoxin risk. So, in the interest of both flavour and health, moldy chestnuts should be removed before processing or consumption.

It is not easy to distinguish moldy chestnut kernels from good ones while they are in the shell, unless they are in a very advanced stage of decay. Even cutting the chestnuts open does not always reveal fungal infections on the kernel surfaces, which is where they usually begin. We have not found any way to assess the fungal decay status of a chestnut other than to peel and examine it. Therefore, grading and quality standards would be much easier to apply to peeled chestnut kernels than to fresh, in-shell chestnuts.

Up to this point, the discussion has mainly centered on keeping chestnuts from molding by keeping them moist. For the best eating quality though, chestnuts need to dry somewhat, a process called curing. During drying, the kernel sugar content increases as starch is converted to sugar (mostly sucrose). When the moisture content reaches about 25% (dry weight basis), the sugar content reaches about 20% (dry weight basis), and the kernel achieves a soft, crunchy texture. At this point, the chestnuts are properly cured and at the ideal stage to eat. Cured chestnuts are very susceptible to molding and must be refrigerated if not consumed. Once chestnuts are cured, no attempt should be made to rehydrate them. In fact, any moisture on cured chestnuts aggravates molding. In summary, before curing, keep them moist; after curing, keep them in the refrigerator and don't allow any free water on them.

Ideally, chestnuts should be cured over a period of one to two weeks under cool temperatures, and then promptly consumed (or processed). Longer curing times often result in increased molding. Chestnuts can be cured in as little as one or two days with warm dry air, but the flavour is not as good, and under quick-dry conditions individual nuts dry very unevenly.

The handling scenario just described specifies that chestnuts be kept moist from harvest until one or two weeks before consumption, then be cured (partly dried), and then promptly eaten. In practice, it usually works fairly well if the grower or packer maintains and ships chestnuts in the fully hydrated, pre-cured condition. Usually several days to several weeks elapses between the packer and the consumer. During this time, the chestnuts are more likely to be subject to curing conditions than moist storage conditions. If already cured chestnuts are shipped by the packer, they often mould or get too dry by the time they reach the consumer. Curing and molding are both irreversible processes. So, it's better for consumers to get the **(next pg.)**

chestnuts before they're cured than after its too late. It's like buying green bananas vs. buying black bananas; the green bananas eventually ripen.

Rather than let the processes of storage, curing, and consumption up to chance, retailers and consumers need to be educated about the proper handling of chestnuts. They need to know how to assess the stage of curing and how to either speed up or slow down the process. Consumers also need to know how to use chestnuts. Education is as important as proper handling. As long as fresh chestnuts are going to be marketed, the handling knowledge and practices need to be brought up to a level comparable to that for other produce items.

One way to circumvent the finicky handling practices and tedious preparation of fresh chestnuts is to market them in some processed form. From the standpoint of taste and convenience, the best product we've come up with is a fresh, peeled chestnut, peeled at the optimum stage of curing. This lightly processed product is highly perishable but may find a specialty niche where it can be produced to order and promptly delivered.

From a more practical standpoint, as well as a quality standpoint, drying offers a simple way to preserve chestnuts, perhaps the best way. When the moisture is reduced to 10-15%, the chestnut kernels become hard, grain-like, and shelf-stable at room temperature. Prompt harvesting followed by quick drying is the best way we've found to minimize mould losses. Drying also kills any weevils that are in the chestnuts. Dried chestnuts are easy to peel, and can be stored peeled or unpeeled. Once they are peeled, cull nuts can be removed (by hand or electronically), and quality can easily be assessed by producer or buyer. There is no problem with moisture loss and accompanying weight loss. Dried chestnuts can be put in sealed containers with modified atmospheres to further preserve quality. The major problem with dried chestnuts is that, presently, they are not commonly traded and there is no large market for them. Assuming that dried, peeled chestnuts can be marketed, this product will provide a market for chestnuts which are too small or too dry for fresh markets. *CGA*

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Bringing 4,000 Guests to Your Orchard (cont. from pg 4)

right away. Last year's baskets included homemade chestnut biscotti (Ken Hunt's delicious recipe) and even a sample of chestnut ground coffee from the American Chestnut Foundation. (No, we aren't promoting the American chestnut, but it's a nice pairing for the biscotti). After the basket is delivered, we call and make sure the news director received it, and find out if he/she has any questions about the event.

When we call a media representative, we act like National Chestnut Week is the very best thing that ever happened to the fall season. Better than football and homecomings and leaves. Better than anything. The enthusiasm is contagious; some reporters have even said it was our enthusiasm on the phone that caused them to pursue the interview or story further.

When a media representative visits your farm, be generous and hospitable. Do not leave the reporter or photographer lost to wander among your trees (or handle burrs bare-handed) not knowing what to feature. Feed them chestnuts. Offer them a prepared packet including your previous media releases or any media coverage you've received. Prepare a CD of images of your farm throughout the seasons. Let them ride along as you use a tractor or mechanical harvester. And don't forget to send a basket of chestnuts back with them to the newsroom. Follow up with a thank you note, letting them know how much you appreciated their visit to your farm.

You may not succeed at grabbing the story the first time, but keep trying – these impressions over time really do make a difference.

Growing chestnuts can be hard – but encouraging the media (and 4,000 guests) to come watch you do it isn't all that hard. You're the expert on your business - Start now! *CGA*

Ken Hunt, left, and Mike Gold, right, Center for Agroforestry, explain the research processes and goals of the Center's chestnut orchards to visiting reporters. (Photo: Bob McEowen, Rural Missouri magazine)

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Recent Introduction into the USA of Ten Chestnut Cultivars from Korea

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Ten cultivars of chestnut were recently introduced into the US from The Korea Forest Research Institute (KFRI), in Suwon, South Korea. Introduction was through the USDA Animal and Plant Health Inspection Service (APHIS) Plant Protection and Quarantine (PPQ) Plant Germplasm Quarantine Program (PGQP) in Beltsville, MD.

Dr. Mahn-Jo Kim sent dormant scionwood from KFRI during the winter of 2006 to Kevin Donnelly at the PGQP (Kim, 2006). In March 2006, I drove to Beltsville with 200 container-grown one-year-old seedling rootstocks. The rootstocks were grown in Chattanooga from seed of Castanea crenata and C. mollissima collected locally. Safely inside the PGQP greenhouse, Kevin and I made 20 grafts per cultivar over the course of two days. I used one whip-and-tongue graft and two or three chip buds per rootstock while Kevin tied and made labels. The grafted plants were later hardened off and moved to a screenhouse facility where they will be grown for the remainder of the their quarantine. The post-entry quarantine period is two years. The cultivars introduced are listed in Table 1. *CGA*

References: Kim, M.J. (2006). Chestnut cultivation and breeding in Korea. J. Amer. Chestnut Found. 20(1): 31-37.

Table 1. Chestnut cultivars graft-propagated in March 2006 at the USDA-APHIS-PPQ-PGQP facility in Beltsville, MD.

Cultivar	Origin	Species	Note
Arima	Japan	C. crenata	Commercial cultivar in Korea
Daebo	Korea	C. mollissima x C. crenata	KFRI patented variety
Ginyose	Japan	C. crenata	Very large nut, widely grown
Ibuki	Japan	C. crenata	
Ishizuchi	Japan	C. crenata	
Okkwang	Korea	C. crenata	Released by KFRI in 1965
Riheiguri	Japan	C. mollissima x C. crenata	Commercial cultivar in Korea
Sandae	Korea	C. crenata	A Korean native cultivar
Tanzawa	Japan	C. crenata	Commercial cultivar in Korea
Tsukuba	Japan	C. crenata	Commercial cultivar in Korea

Crop Update (cont. from pg 5)

Harvey Correia
Correia Chestnut Farm
Isleton, Calif.

"As with much of California, the winter turned out to be a very wet one with heavy rainfall beginning in early January. While it had an adverse effect on many other crops, it doesn't appear to have made much of a difference with chestnuts. The spring was milder than normal, however, so the harvest will probably be at least a week later than in 2005. We had our first significant hot spell develop just before the start of summer so I'm keeping a watchful eye on soil moisture levels as pollination is finishing up. The 2005 crop showed another large increase over the prior year's crop even though I pruned heavier. I did a little less pruning this year and am expecting a larger crop again in 2006. I'll be taking some leaf samples for tissue nutrient analysis in the next week or so.

Something new for this year was some sampling of pollen for vitality analysis. I decided to try this since some areas of our orchard have not set a good crop in past years even though soil and tissue analysis did not reveal anything that pointed to the cause of the problem. I sampled pollen from 20 trees and the testing lab added various levels of boron and calcium to determine their effect on pollen vitality. While a few samples showed decreased vitality with the addition of calcium and boron, several showed significant improvement in pollen vitality. On average, pollen vitality increased 19% with additional calcium and 13% with additional boron. This sort of testing has been used extensively by some larger growers of other nut crops, so I will use this information to supplement other test information. Although leaf samples have shown adequate calcium and high levels of boron, the lab performing my pollen tests indicates they've seen similar situations in other crops and suspect that the elements might be present but unavailable for use by the tree. I've previously applied a lot of gypsum and made foliar sprays in 2004 and 2005 and I plan to make more foliar sprays this year to aid in nut development."

To view pollen analysis results from Harvey Correria's orchards, contact Rachel McCoy, UMCA, by email at: mccoyr@missouri.edu *CGA*

Chestnut Growers of America

CGA
c/o Center for Agroforestry
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See You at the Annual CGA Meeting!
Western Illinois University in Macomb, Illinois
Saturday, July 22

Contact: Ray Young, CGA Secretary/Treasurer,
email: Ray@ChestnutsOnLine.com