

The WESTERN CHESTNUT

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Scionwood Collection Proves Useful for Member Growers

CORVALLIS, Or. -- A few stalwart WCGA members braved chilly temperatures and a dripping sky to collect scionwood at OSU's Lewis-Brown Research Farm in Corvallis, on Thursday, Dec. 21. Organized by members Chris Foster and Anthony Boutard, cuttings were taken from an assortment of varieties at the farm including Bouche de Betizac, Maraval, Marsol, Marrone di Serrino, Layeroka and a Chinese tree provided some years ago to the orchard by Professor Liu Liu of Nanking, China.

Foster said it was a little bit early to cut (2-3 weeks), but he was concerned that unauthorized individuals might deplete the available supply if the collection were postponed.

Scions were cut on 2-year wood, to help maintain moisture during the 4-5 months they will be kept in cold storage until grafting.

Once scionwood was cut, Foster showed participants a collection of nuts from the trees used and others which he had gathered at harvest time. There were distinct differences in size, shape and color. There was some discussion about the difficulty in establishing generic standards when there were such variations in the nuts themselves, and one member suggested that perhaps they should be sold by variety and not by size.

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In This Issue

- 1 Scionwood Collection at OSU
- 1 Cuneo Chestnut Culture
- 2 President's Message
- 3 Letters to the Editor
- 3 Chestnuts Roasting in Boise
- 6 Subsurface Drip Irrigation
- 8 Cook's Corner
- 8 Annual Meeting Information

Local Grower Discovers Chestnut Culture in Cuneo

by Anthony Boutard

The province and city of Cuneo are located in the Piedmont (foothill) region of northwestern Italy, and flanked on the north, west and south by the alps. The rivers flow eastward from the mountains and collect to form broad alluvial plains. The plains are irrigated and grow a wide assortment of fruits, grains and vegetables. Pears, plums, peaches and apricots are densely planted in roughly 12-foot wide rows, with a spacing of 6 foot in the row, and cordoned on high trellises. Kiwi fruit are an extensively planted and important crop for the region. The mountain pastures provide a fine

lessened their value. More recently, some orchards of hybrids have been planted in the plains, but the primary nut producing area remains in the foothills.

Chestnuts grow most abundantly on the lower flanks of the mountains, especially on the north facing slopes. There are extensive wild stands, as well as carefully managed stands of grafted trees. The choicest locations are irrigated by an ancient system of channels built under the direction of monasteries centuries ago.

Roughly 18 distinct indigenous varieties of chestnuts are grown and marketed in the Piedmont, along with six or so Euro-Japanese hybrids. As a rule, varieties have specific uses reflecting their intrinsic qualities. The small, white fleshed and easy to peel nuts of *Frattona*, *Pelosa* and *Siria* varieties dry quicker and more evenly than larger nuts, thus are favored a whole dry nuts or for flour. Historically, they were dried over a slow fire in specially a designed building called a "secou." The *Garrone Rosso* and *Marrone di Chuisa Pesio* with their large nut, golden flesh, and ability to survive the long processing ordeal are particularly desirable for marron glacés. Other varieties are used fresh, with some best boiled while others are better roasted.

Il Tempo delle Castagne

The Province of Cuneo organizes a grand celebration of the chestnut harvest in early October. The heart of the *Fiera del Marrone* takes place on the city's Via Roma which is closed off to traffic for the fair. The street is lined with a series of booths occupied by trade groups, communities and merchants. The air is redolent with roasting chestnuts, local music and song, long leeks of Cervere, sausages, honey and fungi.

See Cuneo, p. 4



Roasting chestnuts on the Via Roma, Cuneo, during *Il Tempo delle Castagne*.

array of cheeses. The sound of cowbells is heard throughout the steep mountain slopes.

The chestnut has been part of the region's culture for thousands of years. The industry is composed of thousands of small family holdings, one to three hectares being typical.

Formerly, chestnuts grew along the river plain near Cuneo. The nuts of this variety, *Temperiva*, mature very early. Early nuts command a substantial premium in the market. Although examples of the cultivar still exist, the larger stands have disappeared as early nuts from more southern localities



MESSAGE FROM THE PRESIDENT

Harvest is over and hopefully all of your chestnuts are sold. Every year brings new experiences in marketing chestnuts. It is extremely important to accumulate as many chestnut clients as possible. We seem to attract a somewhat fickle clientele and there is no assurance that last year's sales mean anything with respect to this year's purchases. Another key to marketing is to start early. It is better to have more orders than you can fill rather than the opposite situation. Orders change and new customers are hard to find late in the season. I find that marketing chestnuts is at least as difficult as growing them. If you catch me on the right day I may admit that it is much easier to grow them.

I am disappointed to inform you that we were not successful with our grant proposal with Dennis Fulbright and Michigan State University. One of the grants was awarded to a well-organized and active organic grower association. I was informed that it will take many applications and some additional organization before chestnut growers across the U.S. will receive this type of grant. Cooperation and coordination among our sister grower organizations is a goal that we should set for our industry. Applying together for these grants is a way to achieve that goal.

Our annual meeting is set for February 1st in Portland in conjunction with the Ag Show. I hope all our members can attend. Please bring your harvest and marketing details with you to the meeting. I find that the information shared by the growers tends to be some of the best information that comes from our meetings. There is no reason we all have to make the same mistakes over and over. I look forward to sharing stories, good and bad, with you in February.

Steve

EDITOR'S NOTES

This is an abbreviated issue so that we might include a renewal/application form and a return envelope to make payment of your 2001 dues easy. Please fill it out and mail to John Schroeder ASAP so that you don't miss your next newsletter.

Anthony Boutard shares the highlights of his trip to Italy, his visit to the chestnut festival in Cuneo, and meetings with growers and others involved in the industry. If you had no desire to travel there before, you will after reading his article.

A visit to Peggy Paul, on the streets of Boise, revealed a lady who is accomplishing her goals of introducing chestnuts to the folks in that city. Marketing is high on her agenda.

In talking with several growers over the last few months I find that some of you are in various stages of planning or installing new irrigation systems. When I came across the included article on subsurface irrigation I thought it might be of interest. SSI is definitely a plus if you're in a position where conservation is important.

Carolyn

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EDITORIAL OPINION

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LETTERS TO THE EDITOR

I'd like to tell you how much I appreciated J. Michael Nave's educating us about colossal chestnuts. The information will shape my nut culture. Also, Durward Smith's article on Thermo Peeling was shown to a fellow tree farmer in Vernonia. He suggested blasting the nuts in a microwave oven. Following were my results when I used his method:

I put 6 1/2 oz. Colossal chestnuts in a popcorn popper. Fifteen seconds of heat exploded the nuts. The shells totally separated from the shredded nut meats. The nut meats were put into a food slicer, producing 1/4" and smaller granules. Then they were air dried at room temperature and then stored in glass jars.

Rudy Bauder, Sr.

emeraldfor@columbia-center.org

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As a kid I grew up in south eastern Canada around the majestic Chestnut Trees -- truly a tree of beauty. As we collected the nuts in the fall we used to buff them on our shirt sleeves to bring out their beautiful color. Over the years the devastating blight wiped them all out. I have always linked the Chestnut with part of growing up as kids. I recently purchased a ski resort inn in southern Vermont and am in the process of re-opening the Inn under a new name.

In memory and fond respect for the Chestnut trees of North America I am renaming the Inn "The Chestnut Hill Inn". I would like to acquire a color photo of a chestnut tree at harvest, or for that matter any chestnut tree that I could place on the cover of our menu and brochure. If you could kindly direct me to where I might find same, it would be greatly appreciated and duly noted in our brochure.

Thank you,

Ray Bachynski of "Chestnut Hill Inn"

cooker@together.net

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Fowler Nurseries, Inc. continues to look for new or improved varieties of chestnuts that are applicable to today's commercial market. In this effort they are evaluating various aspects tree growth and management as well as nut characteristics. One aspect of nut evaluation is how the pellicle adheres and protrudes into the endosperm (invaginations). I have developed some tentative criteria for evaluating pellicle invagination in chestnuts by measuring the depth of the invagination. Nuts are graded as 1, 2, 3, or 4 based on the following criteria: 1--No invagination (2 mm or less on no more than 2 sutures); 2--Minor invagination (2-4 mm on no more than 2 su-

Chestnuts Roasting in Downtown Boise Attracts New Customers

Grower Peggy Paul, of Nampa Idaho, has developed and put into practice her own grass roots marketing plan to promote the increased consumption of chestnuts by those living in the Boise area and it's working well. We recently caught up with her on a Saturday afternoon in front of the Grand Gourmet store downtown near the capitol where she spent the day roasting chestnuts and offering them for sale to passersby. It was about 30°F out and Peggy's setup was complete with a Coleman portable campfire that encouraged folks to stop and warm themselves. Meanwhile the distinctive aroma of roasting chestnuts lay heavy in the air. What motivation to buy!

Peggy has put a lot of thought into her marketing strategy, including a trip to New York to see how roasted chestnuts were prepared and sold there. Her purpose in selling the roasted chestnuts and handing out free samples is not just to create income, but rather to acquaint folks with the nut and to gain retail customers of fresh nuts. It must be working. She tells us that after selling the roasted nuts on the Boise street for the past four years each fall, about 40% of her sales are now retail and that the roasted chestnuts have played a big part in developing that market. At a typical holiday market it is not unusual for her to sell 100 lbs. a day. It helps, of course, that Peggy is a very outgoing person who meets the public well.

Using a Coleman cook stove allows potential customers full visibility of the roasting process. The pre-scored nuts are first parboiled and then put into a long-handled roaster over the stove for about 15 minutes. The nuts are bagged 8-10 to a bag and kept warm on top of the roaster. A sign in front of the stand advertises a bag of nuts for \$2.00. Roasters are also available for sale at the stand and an informational pamphlet is available that includes complete nutri-

tures); 3--Moderate invagination (4-7 mm on no more than 3 sutures); 4--Severe invagination (>7 mm on any 1 suture or more than 3 sutures >4 mm or enfolding of the pellicle within the endosperm on any suture.

Any input from others as to this type of grading and criteria would be most helpful. I can be reached by mail at Lorin Amsberry c/o Fowler Nurseries, Inc. 525 Fowler Rd. ,



Peggy Paul, Nampa, Idaho, spends a Saturday afternoon on the streets of Boise, selling roasted chestnuts.

tional information, handling tips and a recipe for turkey with chestnut stuffing.

In order to sell as a sidewalk vendor the city of Boise requires a vendor license. They are also required to have liability insurance and a food handler's permit. The Grand Gourmet store where the stand is set up had specifically asked that Peggy sell in front of their store, and apparently it's been good for their business as well. Several articles have been done about the Paul's chestnut endeavors including one in the Capitol Press, which appeared last year. In addition Peggy has appeared on a local talk show describing the use of chestnuts in preparing a turkey dinner.

Peggy shows a good understanding of the basics of marketing and her long term goals are paying off as her retail sales continue to increase.

Newcastle, CA 95658 or by e-mail at fowler@foothill.net or by fax at 916-645-7374. I am also working on other standardized grading criteria for chestnut evaluation and will report on them as they are developed. Thank you for your anticipated input.

Lorin Amsberry

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Cuneo, from p. 1

Cuneo's restaurants participate with chestnut-based menus. Dishes included "Zuppa di porcini e castagne in sfoglia" – boletus and chestnut soup served in a hollowed out loaf of bread, "Medaglioni di petto di faraona con frutta secca e castagna glassate" – breast of guinea fowl with dried fruit and chestnut glaze, and "Gnocchi di farina di castagne con ragù di coniglio" – gnocchi made from chestnut flour with a rabbit ragout. The culinary versatility of the chestnut is joyfully explored.

Many of the booths displayed signs declaring "Fattoria Amica" with a logo of a smiling farmhouse. These "friendly stewards" sell cheese, wine, vegetables, fungi and fruit directly from the farm where they are produced.

Others booths have signs noting "Agricoltura Biologica" or "Produttori Biologici." In Europe, "biological agriculture" is equivalent to our "certified organic agriculture." Organic rules are coordinated internationally by a nongovernmental organization, the International Federation of Organic Agriculture Movements (IFOAM), to assure consistency in the standards. In Cuneo, there are 1250 farms which participate. Unlike the US, where the government's posture towards organic agriculture has been one of benign neglect at best, and often antagonistic, it was a pleasure to see the provincial government of Cuneo supporting the growth of organic agriculture.



Hill Craddock points out a healed chestnut blight (*Cryphonectria parasitica*) canker.

In the church "Santa Chiara" there was an exposition of 135 chestnut products from around the world and a comprehensive display of chestnut varieties. Unfortunately, none of the products were available for eating and drinking . . .

San Matteo, Barbassa

The *Fiera* was an occasion to bring prominent people within



Chestnut woodland near Sanfront, Cuneo. Note the litter piled at the base of the trees.

the world of chestnuts to the city, adding greatly to an otherwise excellent trip. We were fortunate to meet Professor Hill Craddock, University of Tennessee, during the trip. He showed us parts of the valley around Cuneo and introduced us to Guido Bassi, whose nursery is described later.

Hill brought us up to an old chestnut holding of grafted trees, variety "garrone rosso." This variety is common in the Cuneo area, and is favored for roasting. It is also an excellent timber tree, commanding a substantial premium for its wood which resists radial checking.

The old stand survived the chestnut blight, with some trees bearing the callused scars from the blight cankers. Unlike the outbreak in America, where the blight was uniformly devastating, in Europe, there is a diversity of virulence in the pathogen. "Hypovirulent" strains do not lead to mortality and often outcompete the more virulent strains. Although blight remains a serious problem, especially in the wounds of newly grafted trees, it is approaching a point of equilibrium. Ink disease, caused by various *Phytophthora* species, is now the more serious management problem.

Chestnuts grown where cows were pastured were grafted, out of necessity, above the animals' reach, generally two meters above the ground or more. The graft unions are clearly visible a century or more later.

The *porcini* fungus, *Boletus edulis*, is an important crop associated with chestnuts in Italy. When cleaning the orchards in advance of the harvest, growers are careful to pile debris from the forest on the uphill side of the trees. There it rots and is thought to improve *porcini* yields. In other sites, growers dig a shallow ditch along the contour of the slope with a grub hoe and drag the fallen branches, leaves and burrs into the ditch where they decay. Either way, organic matter is carefully retained.

Agrimontana s.p.a.

The Agrimontana factory processes honey, fresh fruit and chestnuts. The company is very exacting in their effort to produce the highest quality and distinctive preserves and honey. We were impressed by the fact that no detail is unimportant. Their best preserves have a very high content of fruit and are processed under

Continued on next page
vacuum using only cane sugar, which means no pectin is used. Responsive to the market, they also produce a “light” line of preserves using fructose.

Agrimontana also produces marron glacés, candied chestnuts, chestnut puree, chestnut honey and chestnut liqueur. The marron glacés are carefully differentiated according to place of origin. There are standard marron glacés, Naples marron glacés and Piedmont marron glacés.

Agrimontana cures its chestnuts prior to processing. The “curatura” is important for improving the intrusion of the sugar into the nut. The nuts are cured by soaking and then drying very slowly for 30 days in tufa caves near Viterbo. They are then shipped to the company’s factory in Bologna for peeling, and then to Cuneo for cooking.

For marron glacés, the nuts are immersed in a light syrup and cooked for six days. During this time concentration of the syrup is gradually increased with the addition of sugar. If the sugar concentration is increased too rapidly, the sugar will not migrate all the way into the fruit. If care is not taken during the cooking, the chestnut will fall apart. To date, none of the hybrids make satisfactory Marron glacés. They simply fall apart at the slightest provocation. Marroni are used exclusively for marron glacés.

Ballario

Ballario in Boves (Cuneo) processes and packs fresh chestnuts. Later in the season, when chestnuts are abundant and the fresh market price drops, they peel and freeze whole chestnuts.

It is a highly automated operation. All of the nuts are first cleaned and “sterilized” in a 48° Celsius water bath for 35 minutes to kill the grubs that infect chestnuts. The floaters are skimmed off and the nuts are chilled in a cold-water bath. Then they are graded. How the nuts are graded and sorted is determined by prices at that moment, there is no fixed grading scheme.

Early in the season, nuts are just sorted and shipped. When the quantity available exceeds the capacity of the facility, they cured by soaking in large vats for six days. This soaking is called the “novena” because it originally took nine days. Six is satisfactory. The soaking, a form of the curatura described above, improves the keeping quality of the nuts by encouraging yeast growth, which is antagonistic to other fungi. An earlier form of curatura and storage, no longer practiced, involved leaving the nuts on site in their husks, mounding them in a heap and covering them with the forest litter. The litter was kept moist.

The company also peels and freezes chestnuts. Shelling is done with an 800° Celsius wall of flame. The nuts then go

through rollers to knock off the shell and pellicle, then they put in cool water. The peeled nuts are then packed and frozen.

Vivai Bassi (Bassi Nursery)

The Bassi Nursery grows chestnuts and tree fruits, including an astounding number of apple varieties. The nursery offers 81 varieties of apple, 66 varieties of pear, 22 varieties of peach, and 10 varieties of chestnut. The proprietor is Guido Bassi.

The nursery produces about 26,000 grafted chestnut seedlings annually. They are shipped all over Europe.

To avoid incompatibility problems, chestnut varieties are all grafted onto their own seedlings. Thus *Chuisa Pesio* scion wood is grafted onto *Chuisa Pesio* seedlings. The nuts are collected from the Bassi family orchard in the mountains near Boves, and purchased from other farmers. The nursery needs around 40,000 nuts.

Medium sized nuts are preferred. They are culled for weevil infestation and other damage, then soaked in a fungicide and stored in damp peat moss at 1° Celsius. In the spring, the seeds are planted in beds raised about 10 cm above grade that are covered with drip tape and black plastic mulch. Drip irrigation provides better root structure. Guido estimates that 80% of the root is lifted with the plant. The first year seedlings are very robust and about a meter (three feet) high.

In the second spring, they are grafted using a modified cleft graft. By the end of the growing season, the grafted trees stand about two meters high, and are ready to be pulled and sold in the early spring. Guido prefers spring for transplanting, though some customers insist on late autumn planting. Guido recommends planting the grafted seedlings at the center of a mound that rises 10 to 15 cm above the ground. This reduces problems with *Phytophthora* by keeping the root collar away from standing water.

Guido has established a stool bed using certified disease-free micropropagated chestnut plants. A laboratory in France provided the plants. It is still in the development phase. Generating trees from stools will provide a more efficient means of generating nursery stock.

Raffaele Bassi, Guido’s father, was director of agro-economics at Asperfrut, the research station of the University of Torino. Now retired, he writes for a farming magazine and, with his family, prepares videos on the cultivation of fruits. A video on chestnut management is in the works.

Guido collected the scion wood that Professor Craddock arranged to have shipped to Oregon State University and Burnt Ridge Nursery.

Miscellany

Professor L. Liu from the Institute of Botany, Nanjing, China, was among the dig-

nitaries invited to Cuneo. The kiwi fruit is native to China, and the farmers in Cuneo are the very interested in securing additional varieties in order to remain competitive. In addition, the Chinese are important producers of chestnuts, accounting for about 22% of the world’s production, second only to Korea.

Professor Liu was responsible for arranging the importation of the Chinese Chestnuts (*Castana mollissima*) that are growing at the OSU test plot. Neither the Chinese seedlings nor the Dunstan Hybrids, which are cross between Chinese and American chestnuts, have fared well in the plot. Professor Liu offered an observation, which may explain why the Chinese chestnut is ill, suited to the Willamette Valley. In the parts of China where chestnuts grow, the summers are mild and wet, and the winters are dry. It is the exact reverse of our climate. I hesitate to speculate whether it is the wet winters or dry summers, or both, which lead to poor growth. Whatever the problem, our climate is out of phase with its home.

Books

Here are some recent books about chestnuts:

- Bounous, Giancarlo, and Anna De Guardia Bounous. 1999. *Among the Chestnut Trees in Cuneo Province*. Cuneo (Italy): Edizioni Metafore. 79 p.
An authoritative introduction to chestnut culture. The book packs an encyclopedic punch in a brief and easy to read text. Bonous is professor of arboriculture at the University of Turin, and an internationally recognized expert of chestnut culture.
- Camporesi, Carla G. 1993. *Tiempo di Castagne, Chestnut Time*. Lucca (Italy): Maria Pacini Fazzi Editore. 209 p.
A recipe book devoted entirely to the chestnut. Recipes and background information are provided in Italian and English. The book will satisfy even the truly demented chestnut gourmand for a long time.
- Comba, Rinaldo and Irma Naso. 2000. *Uomini Boschi Castagne, Incontri nella storia del Piemonte*. Cuneo (Italy): Società per Gli Studi Storici, Archeologici ed Artistici della Provincia di Cuneo. 161 p.
Roughly translated “Men of the Chestnut Woods Found in the History of Piemonte,” it is a scholarly ethnobotanical study of the Cuneo region and the chestnut.
- Schena, Elma and Adriano Ravera. 2000. *Castagne per Ogni Stagione*. Pevaragno (Italy): Blu Edizioni. 63 p.
“Chestnut during Every Season” is a more measured recipe book with excellent photographs and historical illustrations. The text is Italian, but it is fairly easy to read, even without any knowledge of the language.

SUBSURFACE DRIP IRRIGATION THE FUTURE OF IRRIGATION IS UNDERGROUND

By David F. Zoldoske C.I.T.

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Placing water beneath the soil surface via buried lines is slowly becoming the "preferred choice" of many vineyard irrigators. The reasons are many, including the absence of surface evaporation, as well as reduced weed growth, herbicide washout, maintenance, injury, and vandalism found with using conventional water application systems. The advantages of subsurface drip add to reduced cost for water usage, labor, chemicals, and liability for property owners.

Additionally, critical timing of surface or sprinkler irrigation practices is eliminated because fields areas can be entered by foot or vehicle during or immediately after an irrigation event. It no longer requires letting the field dry or turning the system off during special or planned activities.

The problem of burying drip irrigation lines is not new. Root intrusion and other problems have caused this approach to be limited in its application or abandoned all together in the past. However, new strategies currently available seem to have overcome this obstacle, making subsurface drip irrigation a viable alternative.

The use of subsurface drip irrigation technology may well be the future of irrigation in the coming years and decades. It begins to treat large scale irrigation projects as hydroponics environments. It holds the promise of reducing mold in grapes, weed growth, chemical use, and optimizing water use. It touches on such issues as groundwater contaminates, drainage problems, water resource management, agricultural chemical use, etc.

What is Subsurface Drip Irrigation?

Subsurface drip irrigation is a variation of traditional drip irrigation where the tubing and emitters are buried beneath the soil surface, rather than laid on the ground or suspended from wires. The products being used today in subsurface drip irrigation come in three basic configurations: hard hose, drip tape, and porous tubing.

Hard hose products generally have wall thicknesses of 0.75 to 1.25 mm (30 to 50 mils), with nominal inside diameters in the 13 to 16 mm range. The emitter is either manufactured as an integral part of the tubing or is inserted later, and is typically placed at a repeated spacing interval of between 0.5 to 1.5 m. The advantages to hard hose products are: strength and resistance to kinking, punctures, and rodent damage. Also, pressure compensating

emitters may be incorporated into hard hose products. A disadvantage of hard hose products can be the initial cost.

With drip tapes, the tubing wall thickness from 0.1 to 0.5 mm (4-20 mils). The thinner materials are more commonly found in single season or throw away applications, typical of strawberry production. The heavier wall materials ranging from 0.35 to 0.50 mm (15-20 mils) are more commonly found in multi-year applications or where the extra strength is required due to stones or other problems identified at the field site.

Some tape products have the emitter formed by the use of glue or other adhesive material used in the manufacturing process, where the actual water channel is made of the tubing material. Other tape or thin wall products have a pre-manufactured emitter glued or attached to the tape wall during the manufacturing process. Emission outlets are typically spaced along the tubing from 0.2 to 0.6 m, with wider outlet spacings having the larger flow path emitters.

Tape or thin products are initially the most cost attractive of the three basic configurations on a per unit basis. The disadvantage of tape products is that they are the most prone to mechanical or rodent damage due to the reduced wall thickness, and thereby reduced structural strength of the tubing wall. However, the use of new generation polyethylene resins are enhancing the mechanical properties of tapes. This is leading to new applications and longer field life.

Porous pipe products emit water all along the length of the tubing. There are literally thousands of places per meter where water weeps out of the tubing. This design has shown resistance to plugging by roots. The disadvantage is its flow path is by far the smallest of the three configurations. This increases the likelihood of plugging by fine particles. It typically has the largest coefficient of manufacturing variability of the three configurations, which can be a major detriment because it prevents high distribution uniformities and high efficiencies (Solomon, 1992).

Other design components of subsurface drip irrigation such as filtration and valving are very similar to those found in conventional drip applications. Proper filtration only protects the emitter from contamination from the inside of the emitter. Unfortunately soil particles and other contaminants can be drawn

into the emitter from the outside. This generally occurs at system shutdown, when a vacuum can develop in the lines and draws water and inorganic particles back into the emitter.

To keep from happening, many subsurface irrigation designs incorporate vacuum relief-valves that break the vacuum and keep water and inorganic particles from moving back into the emitter.

Research by the USDA has shown that the wetted pattern around the buried emitter can be managed by irrigation frequency (Phene, et al., 1987). For example, if the desired effect is to move more water towards the surface, irrigation frequency should be increased.

System capacity of subsurface drip irrigation should be designed to meet 110 to 120 percent of the highest expected seven day evapotranspiration (Et) rate (ASAE, 1991) and (Conrad, 1992). This allows for unseasonably hot weather, or make-up capacity if you get behind in meeting your crops' irrigation needs.

Water use requirements of subsurface drip may not differ significantly from conventional uses. Evidence suggests water applied on top of the ground through conventional drip systems has a cooling affect through evaporation on adjacent plant material. Even though water use in subsurface drip lacks much of evaporation component of Et, it can have higher transpiration rates due to higher crop temperatures (Phene, et al., 1987). The net difference between surface and subsurface drip systems in total Et requirements is small.

Fertilization Through Drip Irrigation

Subsurface irrigation has the ability to apply precise amounts of irrigation water directly to the plant roots. When fertilizers are injected into the water supply they too are delivered directly to the plant roots. In this manner, subsurface drip irrigation has the potential to deliver low fertilizer rates over extended time periods, with increased nutrient efficiency, and lower cost per harvested unit.

When chemicals are added to the water supply there is a potential for undesirable chemical reactions, particularly with phosphorous and some micronutrients. It is always recommended that an adequate water analysis be done before injecting any chemicals containing phosphorous. The introduction of these fertilizers into the irrigation water can lead to the precipitation of phosphates, particularly when high levels of calcium or magnesium are present (UNOCAL 76, 1992). This precipitation will instantly clog emitter pathways and, will cause premature death to the subsurface irrigation system and of course, lead to crop failure.

Studies at the Center for Irrigation Technology

Tape products were first developed as a single season product. At the end of the crop year, the tape was gathered from the fields and burned. As concerns grew about air quality, this practice was outlawed. Then, instead of burning the tape, it was gathered from the fields and trucked to local land fills. Currently, as the capacity of land fills diminished, the cost for disposing of tape products in this manner has risen to the point that it is nearly cost prohibitive.

These environmental concerns and costs associated with the disposal of used irrigation tapes have forced growers to look at long-term placement and maintenance of subsurface irrigation products. Beginning in the fall of 1989, CIT started examining many of the products available in the market place.

Approximately eight different products have been evaluated for performance over the past five years. These products include porous pipes, drip tapes, and hard hose products with compensating emitters and non-compensating emitters. Tubing and emitters were buried in test plots at a depth of 100 mm, using various emitter spacings along the tubing length and between tube placements. The crop was a tall fescue grass. The soil was a sandy loam and the water source was ground water.

Various field spacings were evaluated to identify the most economical and functional spacing to produce an adequate turf quality. While all the products initially provided sufficient water to the turf, product failure began to show up the first year.

One product failed within the first two months of installation. The product design consisted of a single hole, drilled at a slight angle in the tubing. Grass roots began to chase the water back towards the source, easily plugging up many of the outlets. By the end of the first year other turbulent flow emitters began to show signs of plugging due to root intrusion (Solomon, 1992).

The porous pipe products worked well the first year. However, by the end of the second year they began to produce stress in the turf at the end of the laterals. A closer examination showed the product was clogging from the inside, rather than from root intrusion. Even though the water source was considered very clean and was filtered at 200 mesh, small inorganic particles did pass through. These particles eventually built up at the end of the lines in the extremely small water passages found in porous tubing, and drastically reduced the discharge rate from these sections.

What's Succeeding

After nearly five years of evaluating subsurface drip irrigation, two products are still producing good quality turf. These two products use two different strategies to maintain performance. The first product, manufactured by the Netafim* Corporation under the brand name Ram*, is a torturous path, compensating emitter. It appears to offer some type of physical barrier to root intrusion.

The second product is manufactured by Geoflow*, and uses a chemical barrier by the brand name RootGuard*. It incorporates the herbicide Treflan* into the plastic emitter. This produces a slow release of the herbicide which has been shown to be effective in stopping root intrusion into the emitter pathway. The manufacturer claims a 20-year life expectancy with the product and guarantees the "root barrier" for 10 years when properly installed and maintained. Root Guard* treated Drip In* products also produced similar results.

Other Developments

In March of 1993, California labeled for specific tree and vine crops the use of Trifluralin 5* in subsurface drip systems. This herbicide is similar to Treflan*. According to the label, its use is "for pre-emergent control of susceptible weeds that grow in the irrigation zone blocking irrigation emitters and for the prevention of Johnsongrass rhizomes and other weed roots from encroachment into the irrigation emitter zone or subsurface drip line." Recommended rates are approximately one pint per acre. These extremely low rates offer the potential use of other subsurface drip products which have failed in the past due to root intrusion. While it is too early to say if this new application will be as effective in stopping root intrusion. The potential is definitely there.

The use of subsurface drip irrigation should reduce herbicide use. Since California traditionally receives little rainfall in the summer months, weed germination in summer requires irrigation water. If the water is placed beneath the soil surface seed germination should be significantly affected. This should reduce the need for herbicide application saving time and money, and minimize the total amount of herbicides applied.

Furthermore, significant production increases have been shown through the use of subsurface drip irrigation. An example of this is processing tomatoes, where average yields of 30 tons per acre are common with surface irrigation methods. With subsurface irrigation sustained yield of 50 to 60 tons per acre have been achieved (Phene, et al., 1987).

With all the environmental and economic pressures facing growers subsurface irrigation

holds the promise for answering many of these concerns. The increased water use efficiency of subsurface drip irrigation over other methods is substantial (Phene, 1990). This leaves water available for allocation to other uses, such as enhancing environmental goals. Higher water use efficiency also reduces the deep percolation and associated ground water contamination and drainage problems.

*Brand names and manufacturers are used for the convenience of the reader and imply neither preference or endorsement of the products named nor criticism of similar products not named.

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Cook's Corner

While cookbooks may not yet be outdated they're definitely being given a run for their money with all the recipes available on the internet. One site of particular interest for recipes is <http://homecooking.about.com/food/homecooking/library/archive/blv92.htm?rnk=r1&terms=chestnutchestnut> and while the URL appears ominous it's definitely worth the effort to go there.

In the collection are several recipes of historical interest. The following one for Croccanti di Marroni Chestnut Crunch was originally published by Giovanni Vialardi in 1854, and comes from the mountains of Cuneo and the Val di Susa in Piemonte, where chestnuts were a staple winter food. Try it and see what you think.

Croccanti di Marroni - Chestnut Crunch

- 2 1/4 pounds marroni
- 1/2 cup sweet butter
- 3/4 cups sugar
- 2 tbsp whipping cream
- 1/4 lb amaretti, crushed
- 2 oz raisins
- 3 eggs, separated (save the whites for something else)
- 1/2 tsp powdered cinnamon
- Bread crumbs for dredging
- Grated lemon zest
- Olive oil for frying
- 1 egg
- Salt

Boil the chestnuts until tender, then peel them, and press the nut meats through a strainer (you can also use a food mill with a fine-holed disk; were you to use a blender the texture would be different).

Combine the mashed chestnuts, cinnamon, butter, a half cup of sugar, cream, amaretti, three yolks, the raisins and a pinch of salt together in a bowl; the mixture will be stiff. Spread it on your work surface to a thickness of about 3/4 of an inch (2 cm) and let it cool.

In the meantime, grate the zest of a lemon and mix it into the remaining sugar. Beat the remaining egg, and heat the oil for frying. Cut the chestnut mixture into inch-by-inch diamonds, roll them in the bread crumbs, dredge them in the egg, roll them again the bread crumbs, and fry them until golden brown. Drain the pastries on absorbent paper and dust them with the sugar and lemon zest mixture.

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