DEDICATED TO RESTORING THE AMERICAN

Chestnut Tree

The Pennsylvania Chapter of
The American Chestnut Foundation

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Volume 8 Number 2 **P**rinting of the ***Chestnut Tree Newsletter*** is courtesy of **The News Printing Company** of Claysburg, PA **September 2003**
Mailing cost of this newsletter is courtesy of **3 Springs Water Company** of Wilkes-Barre, PA

Ag Progress Days 2003

PA-TACF tent at Ag Progress Days.

We had a very successful three days in August at the PSU School of Agriculture Sciences Ag Progress Days. Thanks to our sixteen PA Chapter volunteers, we presented the chestnut restoration story to hundreds of visitors. Our expanded double tent gave us lots of room for presentations and seedling and woodcraft displays. The Chapter deposited $675 into our account from donations this year.

The chestnut story was also presented in the Ag Sciences building and in the Department of Agriculture Wood Mobile so our exposure tripled this year, for the best coverage ever. During the Wednesday luncheon, **Governor Rendell** commented on the rejuvenation of the chestnut tree population and stated " The chestnut tree can be harvested again for lumber and furniture. That could cause a real renewal in the Pennsylvania economy, and we will reward those types of initiatives."

Board Elections 2003

As of this writing, 42% of our members responded with ballots from the 762 election letters mailed. Thanks for your vote.

To the others who have not responded, **please send in your ballots.** We would appreciate your participation in the PA-TACF election process.

The ballot card already has postage - so all that needs to be done is check three names and drop it in your mailbox. The final date for accepting votes will be October 15th.

Tree Breeding Program Progress

Science Committee Formed

- by Ann Leffel

This issue of the newsletter is devoted to updating the membership on PA-TACF chestnut breeding program.

New Staff - Many of you have met Sara Fitzsimmons, the PA-TACF/TACF staff since the first of the year. She spent most of the first quarter getting the system underway and transferring the data into that system: she will present the system to all chapters at the TACF Annual Meeting. The vision is to have all the chapters using the same data system which will give TACF a portrait of the entire regional breeding program.

Science Committee Formed - Knowing summary of data was forthcoming, the Chapter formed the Science Committee. It is presently composed of only 6 members: Dave Armstrong, the regulator of the purse strings; Bob Summersgill, President, Tim Phelps, manager of our two largest chestnut orchards at PSU; Bob Leffel, Science Advisor; Sara Fitzsimmons, staff; and Ann Leffel, Tree Breeding Program Coordinator. Guest scientists and collaborators are invited according to the Agenda items. The first meeting, March 3, 2003, was convened to review current status, plan spring plantings, consider future plans, and establish our needs and how we plan to address those needs.

On August 28, we held a second meeting. Those in attendance, in addition to the formal Science Committee were: Alex Day, Nursery Operations Manager at Penn Nursery; Dr. Kim Steiner, PSU Professor of Forestry; and Tracey Coulter, PA-TACF Board Member and 2003 Intern. A brief summary follows (check out the new website http: chestnut.cas.psu.edu for the full version):

(Continued on Page 2)

Calendar of Events:

PA-TACF Seed Collection	—	October 11, 17-19
TACF Annual Meeting	—	October 17-19
PA Farm Show	—	January 10 - 17, 2004
PA-TACF Spring Meeting	—	TBA in next newsletter

(Continued from page 1)

Planting Sites -Throughout 2002 and 2003, there had been hope that PA-TACF could locate chestnut plantings at State Bureau of Forestry Penn Nursery; however, legal issues and insurance issues blocked the way. For now, Penn Nursery will do a planting for us that does not involve TACF germplasm. It will be part of a special study to observe the segregation of progeny of a male sterile F1 x American cross as either male fertile or male sterile BC1. The expected ratio is 1 to 1.

Negotiations are underway with New Jersey Conservation Foundation as a potential cooperator. They have a desirable site for a 'Graves' BC3F2 orchard. NJ State Forestry is willing to provide deer fencing. Hopefully a cooperative agreement can be achieved.

Fencing - Dr. Kim Steiner gave us an update on the Penn State Arboretum site. The land has been dedicated as the 'Clapper' BC3F2 site. The Bureau of Forestry fenced part of the land, but the entire orchard will need to be fenced as seed production is increasing each year. The material planted is far too valuable to be left unprotected. It will be less costly to fence all at once rather than by blocks. There is also a need for fencing and removal of 5' tree shelters at the BC3 'Graves' Orchard at PSU on an Ag Progress Days site in Rock Springs. An estimate for total fencing is about $16,000 for those two sites. PSU will share in the costs. Some used fence has been contributed to PA-TACF. We need to pay for transportation to the fencing sites where it can be used.

Deployment – Looking to the future, all are interested in what will happen when TACF has the first BC3F3 seeds or trees (those we think will be blight resistant and sufficiently American). Testing, distribution, restoration, and resources needed have been on the TACF Agenda for several years. As the time gets closer, the discussion becomes more intensified. There are more questions than answers. Keep in mind that this is a first. Although there have been numerous tree improvement programs, no-one has ever tried to ***restore*** forest tree species. That's what makes this program both challenging and exciting!

Current Status of PA-TACF BC3 Breeding Program – Sara Fitzsimmons presented reports on the BC3 Orchards (see summary table below). As of the end of August, she had visited 40 orchard sites, ranging in generations from American to BC3F2. Discussion concerning inoculations to take place in the summer of 2004 also took place. The Science Committee agreed to inoculate a total of **six** orchards next year. There will be plenty of volunteer opportunities here!

Cytoplasmic Male Sterility/Multiple Sources of Resistance/ Conservation Seed Zones
A proposal for testing this methodology for future regional breeding programs in PA was presented at the Chapter Growers Meeting in March. It has also been circulated to scientists and others possibly interested in its potential, for review.

County Coordinators – Dave Armstrong has been active in working with County Coordinators. The orchard managers have also been the pollinators to a large extent.

With their trees now getting to the stage requiring inoculation, selection, and pollination on site, the need for helpers in the field looms large. Anyone having an interest in:

Planting (April, May)
Helping with maintenance of trees (June-Aug)
Inoculating trees (June),
Pollinating (mid-June to mid July)
Nut collection (late Sept- mid Oct)

please let Dave Armstrong at the PA-TACF Office (see front page), or Sara Fitzsimmons at the Penn State office (see page 4), know. It's a wonderful way to spend a day or two among great folks, and to keep in shape all year long. It's a great mission that won't get done by wishin'.

If you can't work in the field, send us a check! This American chestnut tree CAN be restored with your help! It can't happen without your support of our new staff member and our volunteers.

PA-TACF Breeding Program Planting Summary, Plantings from 1994-2003

Type	Cross	Locations	Planted	Alive	Survival
American	Am	50	3965	2782	70%
Chinese	Ch	29	421	277	66%
F1	Am x Ch	38	1001	622	62%
BC1	Am x F1	9	425	260	61%
BC2	Am x BC1	6	553	407	74%
BC2F2	BC2 x BC2	2	1672	651	39%
BC3	Am x BC2	22	9328	7275	78%
BC3F2	BC3 x BC3	1	331	331	100%
BC4	Am x BC3	3	215	214	100%
European	Eu	2	25	25	100%
Japanese	Ja	3	56	52	93%
		Totals:	17992	12896	72%

Table 1. Trees tracked for PA-TACF Breeding Program. Please note that almost 15000 more seed has been collected by PA-TACF, but has been distributed for purposes other than breeding, such as scientific study or seedling sales and fundraisers, and plantings toward the preservation of the species.

Volunteers Young and Older Heart of the Program!!

- by Ann Leffel

Of the many folks who volunteer during pollination season, I'd like to introduce you to two. The tree breeding program would be lost without the dedicated help of all our volunteers, young and older.

Adam Karl – is a senior at J.P. McCaskey High School in Lancaster. He became fascinated with the chestnut tree's characteristics and historical significance. So much so, that he wrote a research paper for school. He joined a tour at the Brogue orchard to learn about the tree breeding program. When Adam becomes interested in a subject, he delves deeply. He has volunteered for two spring seasons of pollinating activities, including bagging, hand pollinating, and pollen collection and drying. He borrowed the literature, read it, and was insatiable in his questioning. He also had the necessary sense of humor to survive this kind of work. He quickly proclaimed after 10 minutes of training, this was "strictly slave labor"! But in spite of the heat, humidity, rain, and the tedium he remained enthusiastic.

Adam is enrolled in the International Baccalaureate program at McCaskey, and is very active in various school programs. An outdoor enthusiast, he worked as a Landmark Volunteer summer 2001, and spent two weeks building new trails with the Appalachian Mountain Club in Maine. Summer of 2002 he was off to Wyoming for a National Outdoor Leadership School (NOLS) course. The course involved backpacking 100 miles isolated territory through the Absoraka Mountains while studying natural history. This summer he went from pollinating chestnuts to a volunteering trip near Aspen, CO. Adam worked on a 1,000 acre land preserve where he maintained trails, herded cattle, and removed invasive species. He plans to apply to Bowdoin College in Brunswick, ME for its wonderful science program. Adam relates, "I think you might want to know that at all of my college interviews, the admissions staff was very interested in my involvement with the American Chestnut Foundation". We're hoping Adam will continue his great interest in and pursuit of chestnut know-how.

Harold Floyd - is the "**chief chestnut scout**" in York, Lancaster, Lebanon, and Schuylkill Counties. An amateur ecologist, he has discovered much about the characteristics and growth habits of American chestnut. At almost 84, he is still hiking the woodland trails on a regular basis, visiting and observing chestnut trees, discovering new ones, and collecting nuts for the chapter. He's been associated with the chapter for at least 8 years. He spreads the good news about the revival of the chestnut tree and hands out newsletters and membership brochures to all he meets who express an interest in the project. The chapter has developed at least 5 breeding lines using American trees that Harold has located and identified for us. Keep on hiking, Harold!

Harold Floyd in action!

hard wired

Websites

The American Chestnut Foundation is making waves on the internet for all you techies to surf! With help from Penn State University, the "Chestnut Growers" website was launched at the beginning of October. This site contains various information, including that regarding to the general culture of chestnut trees, especially as it applies to the TACF and PA-TACF breeding programs. Check out:

http://chestnut.cas.psu.edu

And while you're there, don't forget our other web resources:

PA-TACF webpage	TACF website
www.patacf.org	**www.acf.org**

mailing lists

Another great online resource for TACF and PA-TACF members are the e-mail mailing lists. There are two lists: 1) TACF mailing list; and 2) PA-TACF mailing list. Discussions range from grower observation and questions to interesting chestnut literature. Join both today by going to:

http://chestnut.cas.psu.edu/mailinglist.htm

("New Test", continued from page 6)

strains of the pathogen.Without going into detail, the evidence in hand has to do with unexpected reversals of virulence between the two test strains used by TACF on individual BC3 trees. The next step will be to look for such reversals using parental and progeny arrays of the pathogen on at least two Clapper BC3 trees. This will provide information about the number of pathogen genes involved in the reversal of virulence. If you are interested in more details, please e-mail me or join the TACF ListServe, where I will "publish" periodic reports on this work.

HARVESTING CHESTNUTS

Excerpts adapted from the TACF Field Guide.

Full text may be found at : **http://www.acf.org/field_guide.htm#harvesting**

Harvest your chestnuts when the burs begin to open. This is around the last week in September through early October. If possible, check your trees at least weekly two weeks before the local harvest date. Use heavy leather or rubber gloves. If the burs still penetrate the gloves, put on two pairs.

Wrap a good-quality (Hefty, etc.) black plastic garbage bag around your belt and secure it with a paper clip or twist'em shoved through the bag and around your belt. If you have performed a controlled cross, have a white plastic trashbag in which to put the unpollinated controls. Carry several spare bags in a pocket. If the burs can be grabbed so that the nuts do not fall out, pull them off and put them in the garbage bag. For controlled crosses, remove the pollination bags and place the bags in the white garbage bag. If the burs have opened too far or some nuts have fallen into the pollination bag, cut or break off the whole branch while holding the nuts, or else bend it into the garbage bag to save the nuts. Put all the burs in the bag too so you can count them. Try to avoid cutting off branches to get the burs, though, for this removes many of next year's flower buds. *Be sure to mark the bag with the identity of its contents, be it the cross performed (female x male tree) for controlled crosses, or the identity of the mother tree for open pollinated seed.*

When you get home, remove the burs from the plastic bag, count them and record the count for that cross. Put the unopened burs and the free nuts in an open basket (or something similar that breathes well, to prevent molding), along with an identifying label. Never store burs in plastic bag as the **will** mold. Write the cross identification on the paper bag. Keep the controls separate in the white garbage bag with tag inside. For each controlled pollinations, record bag and bur counts.

If you have a walk-in cooler, put the bags of unopened burs in there to wait for them to open. Otherwise put the bags in a room out of sunlight and reach from mice! Every two to three days, go through the bags removing nuts from opened burs, but do not remove nuts that are still sticking to an opened bur. After a week to ten days, remove all the nuts from all the burs, whether opened or not, sticking or not.

Immediately count and store all nuts in moist, but not wet, peat moss (2-3 cups water per gallon of dried milled peat moss) in a plastic bag into which you have placed numerous holes with a toothpick or paper clip (The gallon Ziploc© bags work well). Make sure each nut is surrounded by peat moss and not touching other nuts or the side of the bag. Put the label in the plastic bag and also write the cross ID and the number of nuts in the bag on the outside with a black Sharpie™. Refrigerate the nuts at 34° F until planting or shipping time.

Contact Sara Fitzsimmons:

Penn State University
210 Forest Resources Lab
University Park, PA 16803
Phone: 814-865-7228
E-mail: sara@acf.org

PA-TACF will have two **nut collection** days for the **2003 harvest**, both to be held in **State College, PA.** You can bring your seed to the Forest Resources Lab at Penn State University on **Saturday, October 11, or to the TACF Annual meeting held October 17-19**.

Please contact Sara Fitzsimmons if you plan on submitting seed for next year's planting, or if you have any questions regarding harvesting.

('Silviculture, continued from page 8)

Similar to the SV test, initial height growth was better with tree shelters than without. However, in sharp contrast to the SV test, trees without shelters have shown very little subsequent growth and heavy mortality because of the continual deer browsing. Mean diameter at age five also shows this (Table 4). Beginning in the third growing season, trees in vented shelters began to surpass those in unvented shelters in height growth, a difference which became large enough to be statistically significant by the fifth growing season.

	2002	
Treatment	**n**	**mean**
P	15	0.3 b
V	23	1.3 a
U	26	1.1 a

Table 4*. Mean diameter at five years of age of 1998 tree shelter study at Tuscarora State Forest; means with different letters are statistically different at the 0.05 level.*

To date, the results of this study suggest that in the absence of deer pressure it is best to grow American chestnut without the aide of five-foot tree shelters, vented or not, if superior height and diameter growth are preferred within five years. Where deer pressure is present, five-foot tree shelters are far more advantageous than no protection, although their was no advantage with a vented over unvented shelter for initial height growth. These tests will continue to be monitored until most trees succumb to blight.

Have you seen me?

PA-TACF is always looking for new American chestnut "mother trees", both for open-pollination seed collection, and for the breeding of advanced hybrid seed.

If you have an American chestnut tree in your area from which you can **collect seed** in the fall, or would like to **pollinate** in the summer, let us know!! For both of these purposes, large trees close to a road that is accessible by bucket truck are most desirable.

All you have to do is obtain a locator form, and send it to Dave Armstrong. If you've already sent one in and had your tree verified, contact Sara Fitzsimmons if you would be interested in pollinating with Meadowview BC2 pollen this upcoming spring.

And now, with the beginning of PA-TACF's newest breeding program, breeding regional adaptability throughout the state while taking advantage of Cytoplasmic Male Sterility (CMS), we're also looking for **Japanese and Chinese Trees**. We'd like to find trees older than 50 years, that are blight-free, and from which pollen can be easily extracted. Keep in mind that we also need good American trees for this program, so keep your eyes on those forests!

Locator forms may be obtained through Dave Armtrong at the PA-TACF Office in Hanover, or through the Pennsylvania chapter's website:

http://www.patacf.org

If you would like to pollinate this summer, but don't know how, or would like a few pointers, just contact Sara Fitzsimmons or Dave Armstrong We hope to organize some pollination learning sessions in late May through early June. Get your name on the list early!

On The Road

- by Tracey Coulter
PA-TACF Board Member
and Summer 2003 Intern

My focus this summer, as the PA-TACF intern, was on mother-tree location and the assessment of American plantings. Sara and I visited plantings and mother trees in 6 states, logged nearly 7,000 miles in her brand new car, saw some awesome trees and many very dedicated growers.

We covered the state from the Poconos to Pittsburgh and found American chestnuts growing in a variety of conditions. One of our trees, the Rock Dump tree near Delano, is thriving in discarded overburden from a coal mine. The Kelley Tree grows in a backyard of Camp Hill, a suburb of Harrisburg. In the Michaux State Forest, scores of American chestnuts were released when an ice storm and subsequent salvage harvest removed the oak overstory. The McConnell's Mill tree, an impressive 70', was discovered in a forest in Lawrence County. Keep looking up folks – there are chestnuts all around you!

The American plantings are also widely distributed. Universal truths remain, however. American chestnuts don't grow well in competition with field grasses. Weed control is key to getting your trees' survival. The rain this year was a mixed blessing – many trees put on amazing growth – but then, so did the grass and weeds. Two years of drought were much to blame for seedling mortality of 60% and more in some areas of the state.

Young chestnuts are susceptible to deer browse and groundhog damage. Fencing and 2' tubes are recommended where possible. Bob and Ann Leffel report good success with a three-wire electrified fence baited with peanut butter. Their farm in York County has relatively low deer pressure. In areas with high deer pressure, 8' high wire fencing is usually sufficient to exclude deer from plantings.

The Chapter's Maintenance Schedule (The Twelve Commandments for Chestnut growers) recommends putting spiral shields on trunks in August to protect the trees from deer rub. It is a sad sight when an otherwise healthy 3" diameter tree is virtually girdled by buck rub. Such wounds also increase the tree's vulnerability to blight infection.

Lecture over – I want to close with thanks and appreciation. Growing American chestnuts helps us all to see what to expect, and what characteristics to look for when selecting the resistant trees. It also helps us to see what other challenges we may face when the blight is conquered, such as leafhoppers, bagworms and voles. Choosing to become a grower is a big decision. I am in awe of the amount of effort that even a small planting requires – thanks to all of you for your dedication, perseverance, and hospitality.

Chestnut Breeding Programs: Present – And Potential?

- Dr. Robert C. Leffel

A second, 15-page draft (15 Apr 2003), with above title, was distributed for anonymous review as widely as possible this spring and summer by Ann Leffel, Chair, PA-TACF Science Committee. The draft included the current PA-TACF backcross program, and the potential use of Cytoplasmic Male Sterility, F1-F2-F3 using advanced BC trees homozygous for blight resistance, self-incompatibility, and intercrossing old surviving American chestnuts. Five of 23 TACF Science Cabinet members responded in some way but only 2 responses considered TACF mission to restore the American Chestnut. Eight additional responses from non-TACF Science Cabinet members have been received and more are being sought. As several reviewers suggest, when uncertainties exist relative to decisions about mating and progeny population, and about resistance selection methodology, etc., consult the "experts" and use best judgment on the advice!! This we are attempting to do!!

The draft questions the advisability of attempting to establish 27,000 BC3F2 seedlings (20 BC3 lines x 1350 open-pollination seed from each line) for each source of resistance, for each region. As reviewers note, TACF is utilizing only three "different" sources of resistance, and selection for resistance is limited to reactions to inoculation with only two strains of the pathogen. (Are the reversals in reaction to mild and severe strains of pathogen noted on several trees at Brogue and Dornsife mistakes in inoculation procedure or plant host/pathogen interactions?)

How to "restore the American Chestnut"? WHO KNOWS?? Assuming the 'Clapper' and 'Graves' sources of resistance and current inoculation techniques adequate, are there alternatives to the present TACF breeding program that are more reasonable in scope and more probable for success, which will contribute to a larger task of "restoration of the American Chestnut"? Utilizing the current BC3 lines produced by PA-TACF, alternatives include the development of synthetic varieties of: 1) "Timber-type", blight-resistant chestnuts, or (2) "American-like", blight-resistant chestnuts. The first alternative will be the easier if selection is for resistance and tree-type only. Are there desirable characteristics of Chinese Chestnut other than blight resistance?

The selected BC3 lines can be utilized efficiently in the development of synthetic varieties, as has been done with self-incompatible, wind-pollinated forage species for more than 50 years. The potential performance of synthetic va-

(See Chestnut Breeding, Continued on page 7)

A New Test for TACF Resistance Genes

- by Timothy McKechnie

The current TACF breeding program is based on multiple untested assumptions. This is a normal part of doing practical breeding work. In practical work it is usually necessary to make some assumptions, and to test them as you go. In Pennsylvania, there is now an opportunity to begin testing one of the central assumptions, namely that TACF Clapper resistance genes apply equally to all strains of the fungal pathogen.

To complete this sort of work (in a "scientifically publishable" form) could be extremely expensive and certainly would take years of effort. In part, that's probably why TACF has not devoted many resources to this work. However, it is not really necessary to do a complete study of this kind. It should be enough to do a few preliminary studies. If such preliminary studies indicate that just one Clapper resistance gene does not work against just one strain of the pathogen, that observation alone will indicate that a different testing and breeding plan may be needed.

Timothy is a graduate student at the University of Massachusetts, Amherst, and is a former employee of TACF. He may be reached by e-mail at: **mckechni@earthlink.net**

For example, a plan utilizing and/or combining many more sources of resistance may be more appropriate.

It has been argued that the best way to test TACF resistance is to plant as much as 200,000 acres and see how the trees do. Certainly, if TACF hybrids grew to healthy maturity in such a large planting, one would be encouraged to plant more of the same. However, a large-scale test in nature is not necessarily the cheapest or fastest way to test TACF resistance genes.

Another way to test TACF resistance might be to hit a few selected BC3F3s with a large variety of natural isolates of the pathogen. Again, if the trees did well, one would be encouraged to proceed with a larger planting and further tests. However, as far as I know, such a preliminary test is not being planned. Since it would involve more than one resistance gene at a time, such a test would not necessarily reveal the plant-pathogen interactions of greatest interest.

Based on inoculations of Clapper BC3 trees at the PA-TACF Brogue 1997 planting, there is good reason to begin another kind of testing program. Working with Dr. Hebard and with advice from Dr. Seogchan Kang of the Penn State plant pathology department, my tests will be designed to isolate and examine resistance genes one at a time. It may be possible to learn all we need to know from only a few dozens of Clapper hybrid trees, and a few well-chosen

(See "New Test", continued on page 3)

(Chestnut Breeding, Continued from page 6)

rieties depends upon: 1) the performance of BC3 lines; (2) the number of BC3 lines combined; 3) the performance of the F1 crosses (BC3F2) among the BC3 lines, i.e., the 380 F1 single crosses among 20 lines counting reciprocals [n(n-1) = 20 (19)], and (4) the extent of cross-pollination. The performance of the synthetic will depend upon the balance among these four factors: we know nothing about the F1 crosses among the BC3 lines. There may not be a direct relationship between the number of BC3 lines included in a synthetic variety and its expected performance unless all lines are equal in combining ability. The most desirable synthetic may involve fewer BC3 lines than 20! The performance of the second generation of synthetics, Syn 2 (BC3F3) is expected to be below that of Syn 1 (BC3F2), but with random mating, complete cross-pollination, and no selection, the performance of the synthetic will eventually stabilize.

Inbreeding should not be a serious factor in the advanced generations of the synthetic. A reviewer concludes: 1) TACF proposed breeding strategy spends too much effort to avoid inbreeding and inbreeding may be common in wild populations of *C. dentata*; and (2) the large and cumbersome breeding strategy is largely based on unproven hypotheses and poses serious logistical and cost challenges. The minutes of TACF Science Cabinet Meeting 25-26 July 2003 indicate the Hardwood Tree Regeneration and Improvement Center at Purdue may be more interested in developing a chestnut cultivar than in chestnut restoration. If so, why?

The strategy proposed by TACF to restore the species is based on a great concern for "loss of rare alleles" – and quotes much theory to support such concern. Yet the author of TACF breeding strategy stated recently: "Regarding rare genes, it is important to remember that they may not be of any adaptive significance whatsoever." Has such theory been documented by restoration of species such as whooping crane, bald eagle, buffalo, wolves, grizzly bears, etc. The Golden Hamster breed originated from a brother-sister mating many generations ago. Would there be any hope if we find one male and one female passenger pigeon? One wit suggests that it depends on their ages!

To date, I have no compelling reason to change my recommendation of 500 BC3F2 seed per single cross, or 1000 BC3F2 seed per maternal BC3 line produced by open-pollination, or some combination of the two types of progeny: a total of 5000 to 10,000 BC3F2 seed per source of resistance, rather than the 27,000 now proposed for a 20 BC3 line open-pollination intercross.

Chestnut Silviculture Studies, part I

- by Tim Phelps, Research Support Technologist, Penn State University

Having firm belief in TACF's breeding program to introduce a blight resistant hybrid of American chestnut, Dr. Kim Steiner, Professor of Forest Biology, and Jim Zaczek, Research Assistant, both with Penn State's School of Forest Resources, began studying methods for chestnut reintroduction in 1997. Zaczek is now an Assistant Professor with the Department of Forestry at Southern Illinois University and continues to work with chestnut in that region. Steiner and the author continue to study reintroduction strategies for PA, and the following is a snapshot of results gained thus far. Currently, there are three active studies in progress – (1) tree shelter test, (2) container/nursery stock test, and (3) site evaluation test. This column will focus on the tree shelter test. The other tests will be included in future newsletters.

In many regions of PA deer protection is essential to establishing healthy forest seedlings. Five-foot tree shelters are relatively effective in protecting seedlings from deer until the tree grows above their reach. The shelters also provide greenhouse-like growing conditions as they harbor sunlight, reduce transpiration rates, and protect the seedlings from outside environmental stresses. Tree Pro, a manufacturer of tree shelters, produces a vented shelter designed to encourage the seedling to harden-off normally in the fall by allowing more air circulation through the shelter.

In 1997, a tree shelter test was established at Stone Valley (SV), Penn State School of Forest Resource's Experimental Forest in Huntingdon County. The test was designed to measure the effect on height growth of two different types of five-foot tree shelters (Tree Pro) – vented (**V**) and unvented (**U**) – vs. no tree shelter (**P**), where the seed was planted only with a seed protector to inhibit predation. Fifty American chestnut seed were planted for each treatment in a randomized complete block design. The site was established in a recent shelterwood harvest and a six-strand electric fence was erected to provide deer protection. However, this area has a very low deer population, thus the need for deer protection is minimal. Table 1 shows survival and height growth performance for each year through 2002. As suspected, initial height growth was significantly better with the two types of tree shelter than trees without shelters, however there was no difference between the types of shelter in any year. During the fourth growing season (2000), though, trees with no shelter began to catch-up to where there was no difference. In fact, after the fifth and sixth growing seasons, trees that were allowed to develop with no tree shelter were substantially taller than those that had developed with a tree shelter. Table 2 also indicates that no

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shelter is also better in terms of tree diameter after the sixth growing season.

	1997		1998		1999		2000		2001		2002	
Treatment	**n**	**mean**	**n**	**mean**	**n**	**mean**	**n**	**mean**	**n**	**mean**	**n**	**mean**
P	20	1.5 b	20	2.6 b	20	6.1 b	20	9.8 a	20	13.8 a	20	17.8 a
V	33	2.9 a	33	4.1 a	33	7.0 a,b	26	8.7 a	24	11.3 b	22	14.0 b
U	32	3.0 a	32	4.1 a	31	7.4 a	21	8.7 a	19	11.0 b	19	12.9 b

***Table 1**. Survival (n) and mean height (feet) of the 1997 tree shelter study at Stone Valley Experimental Forest. Means with different letters within a column are statistically different at the 0.05 level.*

	2002	
Treatment	**n**	**mean**
P	20	2.0 a
V	22	1.3 b
U	19	1.4 b

***Table 2.** Mean diameter (cm) at six years of age of 1997 tree shelter study at Stone Valley Experimental forest. Means with different letters are statistically different at the 0.05 level.*

Certainly, had there been appreciable deer pressure at this site, unsheltered trees would have had much more difficulty in getting established and surpassing the deer-browse line. We did discover another threat at this site thought: bears. Many of the shelters were bent in half as a result of one or more bears, which perhaps were feeding on wasps that often inhabit the shelters. Table 1 shows a marked decrease in survival (n) of trees protected by tree shelters between the 1999 and 2000 growing seasons due to bear damage as trees were snapped in half (damaged trees were removed from the data set). All remaining shelters were removed in 2001.

A replicate test was established in 1998 at the SV site and another in Tuscarora State Forest (TSF), about 70 miles to the south in Perry County. Unfortunately, the SV planting was continually ravaged by bear damage and we finally removed it from the study in 2002 with inconclusive results, although trends were similar to the adjacent 1997 trial. The TSF site differed primarily in the amount of sunlight reaching the forest floor as it was established in a recent clearcut (The SV site is a shelter wood cut). This site also had an electrified fence, but the fence was largely ineffective, and there was heavy deer damage to vegetation. Table 3 shows survival and height growth performance at TSF for each year through 2002.

	1998		1999		2000		2001		2002	
Treatment	**n**	**mean**	**n**	**mean**	**n**	**mean**	**n**	**mean**	**n**	**mean**
P	33	0.5 b	29	0.8 b	23	1.1 b	19	1.5 b	15	1.7 c
V	33	0.8 a	34	4.3 a	32	7.2 a	30	9.4 a	23	11.5 a
U	31	0.8 a	31	4.3 a	32	6.5 a	31	8.2 a	26	9.6 b

***Table 3.** Survival (n) and mean heights (feet) of the 1998 tree shelter study at Tuscarora State Forest. Means with different letters within a column are statistically different at the 0.05 level.*

(Please see 'Silviculture', continued on page 4)