

Ohio Report on American Chestnut Planting between 2003-2004

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Protected American chestnut seedling planted at Linton Road site

American Chestnuts And Mine Land Reclamation

One of the goals of land reclamation in the Ohio Department of Natural Resources, Division of Mineral Resources Management (DMRM) is to plant disease-resistant American chestnuts (*Castanea dentate*) on mined land as they become available. Restoration of this species on abandoned and active reclaimed mined land of southeastern Ohio is considered economically and environmentally important for wildlife habitat, timber production and watershed conservation in the region. The initial goal of the Division is to develop strategies for how chestnuts should be planted, what site offers the best opportunity and how special handling or treatments may enhance their survival. The Division also desires an independent review on survival and growth in order to guide future efforts.

Background

The Division has been planting seedlings inoculated with ectomycorrhizal fungi for many years as part of its Reforestation Program. The ectomycorrhizal fungi *Pisolithus tinctorius* (P.t.) helps seedlings survive in low pH strip mine spoil and gob piles by forming a symbiotic association with the fine feeder roots of tree seedlings. The mycorrhiza treatment increases the tree's ability to absorb water and nutrients under harsh conditions.

The late Dr. Ed Cordell of Plant Health Care, Inc., a consultant on inoculating seedlings at the Marietta Nursery, indicated the American chestnut made a good host for the *Pisolithus tinctorius*. In Fall 2003, the U.S. Forest Service (USFS) at its Northeastern Research Station in Delaware, Ohio had been conducting research on this program and provided the Division approximately 200 P.t. and non-P.t. seedlings. The non-P.t. seedlings were planted on the Linton Road reclamation project in Coshocton County. The P.t. seedlings were also planted at the Campbell's Ridge reclamation site in Belmont County.

In the summer of 2004, the American Chestnut Foundation Ohio Chapter representatives Dr. Carolyn Kieffer, Miami University of Ohio and Dr. Brian McCarthy of Ohio University offered to obtain approximately 500 BC2 partially disease-resistant American chestnut seeds to be planted on mined land for study. These were planted side by side with the pure American chestnut to evaluate plant performance on different coal seam spoil types and under varied reclamation conditions.

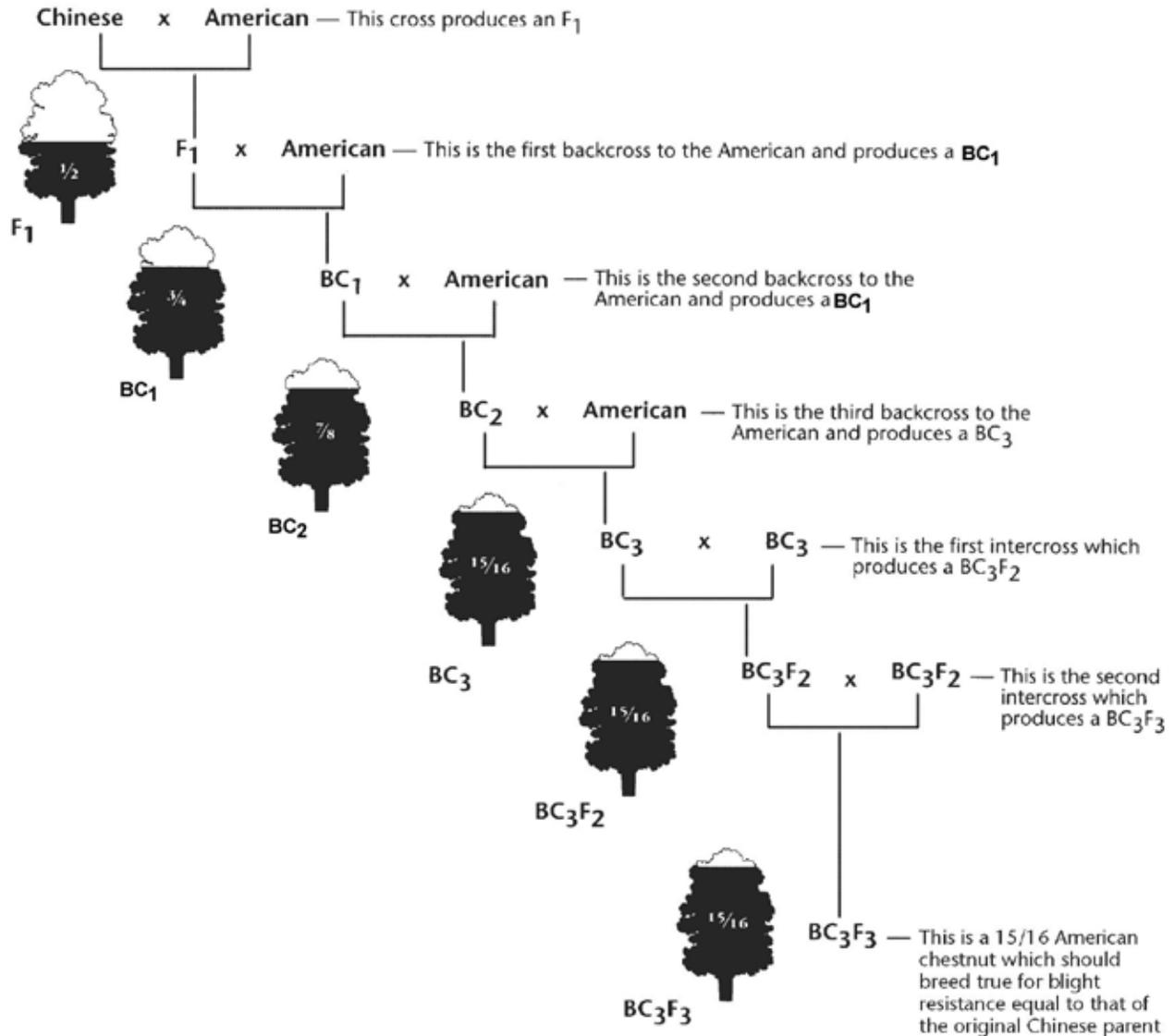
The seeds were shipped from the American Chestnut Foundation in Tennessee to Ohio's Marietta State Nursery and inoculated with P.t. in the nursery beds. The pure non-P.t. chestnuts were also obtained from the American Chestnut Foundation the following spring. During the spring 2005 planting, an additional 100 chestnuts were obtained from the USFS Northeastern Research Station and planted at Tri Valley Wildlife Area with the P.t. and non-P.t. plants from the American Chestnut Foundation seedling source. These sites were also planted with other species since the plots were relatively small compared to the total site size.



Figure 1. Marietta State Nursery beds of BC2 American chestnut seedlings inoculated with ectomycorrhizal fungi (*Pisolithus tinctorius*).

THE AMERICAN CHESTNUT FOUNDATION'S BACKCROSS BREEDING PROGRAM

WITH EACH BACKCROSS, ADDITIONAL AMERICAN CHESTNUT CHARACTERISTICS ARE REGAINED. ONLY AT THE FINAL INTERCROSS, HOWEVER, IS BLIGHT RESISTANCE EQUAL TO THAT OF THE CHINESE PARENT RESTORED.



Note: In each step, the backcross is selected for resistance. Trees indicate average fraction of American genes with no selection.

Planting Site History

The four planting sites selected represent four distinct spoil and soil types within the Ohio coalfields where strip mining is most prevalent (Table 1). The sites also reflect reclamation practices from different time periods and legal reclamation requirements for mining operations in eastern Ohio.

The Perry State Forest site is on raw spoil associated with the No. 6 Middle Kittanning and No. 5 Lower Kittanning coal seams in Perry County. These seams are acidic and have been barren since the early 1960s. The Perry Site would be considered “pre-law” or before Ohio’s 1972 modern reclamation law. Prelaw sites reclaimed under this law are characterized by a lack of topsoil, minimum grading, steep outcrops and highwalls. Previous plantings of P.t. treated seedlings were completed by the Division in 1988 and 1990.

The Tri Valley site located in Muskingum County was mined by Boich Mining Company in 1972 shortly after passage of Ohio’s reclamation law. The site is a “B” permit which required backfilling and placement of a minimum of six inches of resoiling

material. The soil has a pH of 4.6. The coal mined was the No. 6 Middle Kittanning coal seam.

The Campbell’s Ridge site is pre-law and was mined prior to 1965 with little reclamation other than some grading. The site has most of its spoil and topsoil wasted around the edges with black shales and coal material exposed on the surface. The spoil was predominately limestone but this has been buried by toxic material. The coal seam mined is the Meigs Creek No. 9 and this site is in Belmont County.

The Linton Road site is a pre-law underground mine site in Coshocton County that was reclaimed by the DMRM Abandoned Mine Land Program with assistance from the U.S. Army Corps of Engineers and the Clean Streams Program. The reclamation goal was to seal the mine and construct a wetland to treat water in a passive manner prior to entering Wills Creek Lake. The parent material in this area is sandstone and the site was reclaimed by using borrow material of good quality and texture.

Three of the four sites consist of mined land that has been acquired by the state or federal government. One site is private land (Campbell’s Ridge) formerly owned by Consolidation Coal Company.

Table 1. Soil Test Information

Sample	CEC	pH	Nutrient Recommendations (lbs/acre)			Texture (%)				Lime Appl (tons/acre)
			N	P	K	Sand	Silt	Clay	Class	
Tri Village	13.4	4.6	20	85	210	17	36	27	Clay loam/loam	7.5
Campbell's Ridge	18.5	4	15	90	260	10	38	52	Silty clay	7
Linton Road	8.6	7.1	20	75	170	35	34	31	Clay loam/loam	0
Perry State Forest	16.1	4.2	10	95	250	51	28	21	Sandy clay loam/loam	11.5



Campbell’s Ridge, October 2003 - Planting site for American chestnut

Future Evaluation Of Seedlings And Plantings

The chestnut sites were evaluated by Dr. Kieffer and Dr. McCarthy over a two to three year period for plant performance. The BC2 American chestnuts were only planted at locations on public lands and will be accessible for continued review or studies over the course of time. The documented history of these plantings will also assist with future studies.



Matt Shupert and crew from Mining and Reclamation Inc. during Perry State Forest planting in Perry County

Perry State Forest

This barren site exhibits low pH soil conditions that have existed since mining in the late 1950s when reclamation laws were inadequate. The site is on the edge of an area planted in 1990 by DMRM.

Approximately 50 P.t. BC2 American chestnuts as well as 50 non-P.t. pure American chestnuts were newly planted with planting bars and marked accordingly. In addition, P.t. seedlings from the U.S. Forest Service's Northeastern Research Center in Delaware, Ohio were planted around the chestnuts. Wire mesh was placed around each seedling to reduce deer browse on the seedlings, a problem on



Perry State Forest, Spring 2005 - American chestnut

previous plantings of American chestnut seedlings obtained from the West Virginia Forest Nursery. Those plantings experienced low survival rate due to heavy deer browse.

Campbell's Ridge

This site was planted with 98 P.t. American chestnut seedlings obtained from the USFS in fall 2003. In spring 2004, additional planting of a mix of 8,000 P.t. Virginia pine, red oak, white pine and sawtooth oak occurred around this area. The site had very little tree growth 50 years after mining ceased. The chestnuts were planted in the potting soil material in which they were grown. Protective plastic sleeves were placed around 30 percent of the seedlings to protect them from deer browse.



Campbell's Ridge, Summer 2004 - American chestnuts one year after being planted on spoil with a pH of 4.0

Linton Road

Approximately 100 pure American chestnuts were planted in late fall of 2003 immediately after the site was reclaimed. No protective measures were given the seedlings. In early spring 2004, the site was planted with an additional 1,000 green ash, 1,000 sweetgum, 200 tulip poplar and 500 black locust. DMRM felt this planting would be more successful since the seedlings were planted in ground seeded with grasses and legumes prior to any vigorous growth. There was little competition from the grasses initially. This planting is more reflective of recent reclamation methods used by the coal industry

on active mine sites and on abandoned mined land projects.

Planting in 2005 included 50 P.t. treated BC2 7/8 chestnuts and 50 pure American chestnuts. Seedlings were protected from deer browse with staked wire mesh. Washed river gravel was placed at the base of each plant to protect against rodent damage. In addition the planting area was treated with herbicide to decrease competition from herbaceous vegetation. The spraying was done by hand using a four-wheel ATV since access to the planting area was not favorable to farming equipment.



Perry State Forest, Summer 2005 - Pure American chestnut



Linton Road, 2003 - American chestnut of USFS stock

Tri Valley

The site is generally flat which allowed for herbicide application using standard farming equipment. The herbicide Oust® was used for the entire site. Spacing for the spray application was approximately 8 feet. The trees were provided wire mesh browse protectors and No. 57 washed river gravel was placed at the base of each plant. Seedlings of other species were not protected and were hand planted along the herbicide application rows.

Approximately 86 American chestnuts obtained from the U.S.F.S. were planted along with 75 P.t.-treated BC2 7/8 chestnuts and 75 pure American chestnuts obtained from the American Chestnut Foundation. In addition, approximately 3,500 other seedlings were mechanically planted and included sweetgum, green ash, white pine, sawtooth oak and red oak.

Effectiveness Of Plantings

At Perry State Forest, three seedlings of the pure American chestnuts were removed to evaluate if P.t. had colonized the roots. This was done by students under the direction of Miami University professor Dr. Carolyn Kieffer and Ohio University professor Dr. Brian McCarthy. Per Dr. Kieffer, test results conclude that colonization did occur.

The survival rate for both P.t. inoculated and pure American chestnuts was 95%. The P.t. chestnut survival was 93%. The plantings of P.t. Virginia pine had a survival rate of approximately 95%.

Approximately 36% of the American chestnuts at Campbell's Ridge survived after the fall planting of 2003. Much of the mortality could be attributed to a late fall planting and deer browse. The plants were planted in the potted soil material in which they were started. There was substantial evidence of frost heave with these trees having exposed roots at the surface. The remaining trees planted on the site the following spring have a survival rate of 80% based on test plot data.

The Linton Road site has the lowest survival rate of the three evaluated sites at 66%. A field review in September 2006 confirms that this figure may be 64%. The other species planted on the site have a higher survival rate of 88% and include black locust, sweetgum, sycamore, green ash, and tulip poplar. These seedlings were planted one year prior to the

chestnuts when the site was first seeded and mulched and had little competition from the grasses.

Approximately 18 of the American chestnuts planted in the fall of 2003 remain. A small landslide wiped out another 15 American chestnuts on the south side of the project.

The Linton Road site had a heavy cover of forbs develop as a result of fertilization, as well as evidence of high deer browse damage in spite of the wire cages protecting the seedlings. Both these factors could be the reason for lower chestnut survival rate.

The Tri Valley site had a 90% survival of all chestnuts, as independently determined by Ohio University student Robert Herendeen who compiled all the data on the chestnuts. The other species are doing well and, based on past experience and site characteristics, are also expected to have at least an 85-90% survival. The evaluation on the other seedlings will not be verified until spring 2008 based on this late fall evaluation.

Of all the plantings, the P.t. treated trees exhibited a more robust growth and this was evident more so on raw spoil according to the study. The recommendation resulting from this review was that bareroot hybrid seedlings be inoculated with vegetative mycelial P.t. at the nursery, treated with Terrasorb, and out-planted directly into non-reclaimed sites or non-resoiled spoil.



Campbell's Ridge, Summer 2007 - Three year old American chestnut and two year old white pine



Linton Road, 2008 - Young American chestnut trees along with sweetgum, ash, black locust, tulip poplar and sycamore

Transferability To Other Reclamation Sites And Operations

The planting of American chestnuts on mined land has great potential for both regulated and older abandoned mine land sites. The American chestnuts inoculated with *Pisolithus tinctorius* (P.t.) performed well on mine spoil as well as other sites. Inoculated seedlings showed more robust growth, greater stem diameter and lower branching. The pure non-inoculated chestnut seedlings displayed tall slender stems. The best performance favored bare, unreclaimed spoil as opposed to grass or forb cover.

During reclamation planning for active strip mine land, consideration should be given to returning some of the site to forest land. This would be considerably important for areas in which the coal operator is remaining pre-law areas since these lands are marginal lands where forest land would be the highest and best use. This also applies to steeper slopes on non pre-law areas. The final graded highwall slope and the old spoil out slopes would provide a less compacted soil profile and thus a site which has a higher site index to promote better tree seedling growth. Any soil recovered from the mined and/or reclaimed site would be best placed on more gentle slopes. This would optimize both forest land and pasture/hay land based on slope characteristics and save soil where it would be better utilized. This should also apply to

sites reclaimed through the Abandoned Mine Land Program.

Long Term Benefits

Based on this review, the American chestnut has a high potential to fit into mining and reclamation programs with good results. Mining and reclamation activities by coal mining companies and the state Abandoned Mine Land Program could be the vehicle for restoration of the American chestnut in much of the Appalachian coalfield region. This would benefit wildlife, watershed protection, and the public with a future timber crop and nut production. Placement of other species suited to these sites, such as red oak and other species inoculated with P.t., would further compliment the reforestation of these mined sites.

Based on Robert Herendeen's Master of Science thesis, the plantings completed on three of the four sites have provided a good baseline of data courtesy of Ohio University, Miami University, and the Ohio Chapter of the American Chestnut Foundation. Three of the sites are on public lands and will remain accessible, allowing monitoring and further study of the seedlings as they mature. In addition, it may be possible to backcross some of these trees once they mature to obtain BC3 15/16 progeny (nuts) for the future.



A healthy American chestnut, the ultimate goal of the American Chestnut Breeding Program. Photo courtesy of the American Chestnut Foundation.



Perry State Forest outlopes, June 2008 - Mike Hiscar, OSMRE stands next to a six foot tall P.t. treated BC2 7/8 American chestnut and P.t. Virginia pine