



## Establishing Hardwood Forests with American Chestnut Using a Forestry Reclamation Approach: Effects of Grading Practices and Groundcover

**Authors:** James Burger and Carl Zipper

**Affiliations:** Virginia Polytechnic Institute and State University

### Project Description and Objectives:

This project investigated effects of soil grading and seeding practices on mine reforestation success in Appalachia.

### Applicability to Mining and Reclamation:

Reclamation seeding practices influence the emerging plant community. Herbaceous seeding that provides lower levels of initial groundcover are more favorable for re-establishment of native plants than conventional seeding practices. Herbaceous seeding influences establishment of species carried into the site as seeds by wind and wildlife. Results can be applied across the Appalachian region.

### Methodology:

Three experimental sites were established on southwestern Virginia mines. At each, two grading (smooth-grading and loose-grading) and three seeding treatments were installed. Seeding treatments were 1) conventional, to create dense groundcover rapidly; 2) tree-compatible, to create a moderate level of initial groundcover; and 3) annual ryegrass, to create the lowest level of initial groundcover.

All sites were hand-planted in early 2008 with seedlings of 13 native tree species. Due to poor seedling viability, all sites were re-planted in January 2009. In addition, six breeding generations of chestnut (2 American, 3 American-Chinese hybrids, and 1 Chinese) were also planted as nuts on the loose-graded plots.

Measurement plots were established to evaluate treatment effects. All trees within the measurement plots were identified, enumerated by species, and measured for height and diameter. Survival and growth for chestnut was measured separately by tallying and measuring diameter and height for all emerged seedlings. Herbaceous groundcover was measured, overall and by species.



*An experimental plot containing the annual ryegrass seeding treatment in August of the second growing season. Both dead plant material comprised of the prior year's annual ryegrass growth and living biomass of volunteer species that entered the site as seed are visible.*

### Highlights:

Important conclusions of the study include the following:

Non-planted and native herbaceous species richness was greatest on annual ryegrass areas. Although neither grading nor seeding practices influenced planted seedlings during the first year given adequate and consistent rainfall, past research suggests that differences will emerge with more time. Chestnut survival was greater in the annual ryegrass treatment than in the conventional seeding treatment. Annual ryegrass seeding appears promising as a potential reclamation practice when restoring native forest vegetation where site properties are favorable for native species invasion.

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## Results and Findings:

Neither grading nor seeding treatments had significant effects on tree survival or height growth over one year given adequate and consistent rainfall. Chestnut survival was greater in the annual ryegrass treatment than in the conventional seeding treatment, but no height differences among seeding treatments were observed over two years. During 2009, however, height growth of chestnut trees in ryegrass plots was twice that of plots with denser ground cover. There was a gradient in growth among chestnut breeding generations: Chinese > hybrids > American.

Conventional seeding produced more total groundcover than annual ryegrass, but all seeding treatments provided adequate cover for erosion control. As ground cover increased, water infiltration increased; annual ryegrass seeded allowed lower rates of water infiltration than the other seeding treatments.

Eleven herbaceous species were seeded but forty two were identified. Seeded species produced more groundcover than volunteer species, non-natives produced more groundcover than natives, and invasives produced more groundcover than non-invasives, but most of the non-native and invasive groundcover was provided by seeded species.

Annual ryegrass seeding had less overall groundcover, less coverage by seeded, non-native and invasive species, and more coverage by volunteer species than the conventional seeding. Volunteer, native, non-invasive, and overall richness was greater for annual ryegrass than for other seeding mixes. Grading had no effect on herbaceous species richness, groundcover, or richness by species type.

Further information is in two published works:

1. C. Fields-Johnson and others. 2012. American chestnut restoration techniques on reclaimed Appalachian surface mined lands. *Ecological Restoration* 30:99-101.
2. C. Fields-Johnson and others, 2012. Forest restoration in steep slopes after coal surface mining in Appalachian USA: Soil grading and seeding effects. *Forest Ecology and Management*. 270: 126–134.



*One set of experimental plots in October of the third growing season. The greater herbaceous species richness of the annual ryegrass treatments (foreground), relative to the conventional seeding treatment (adjacent and behind), is evident.*



*Research cooperater Eddie Clapp (Red River Coal Co.) standing with a chestnut seedling that has grown from a nut planted on the loose-graded experimental plots. Nuts were planted in early 2008; this photo was taken in August 2011.*

### Fact Sheet Contact Information

PRINCIPAL INVESTIGATOR (PI):

James Burger and Carl Zipper  
 jaburger@vt.edu, czip@vt.edu, 540-231-9782 (Zipper),  
 Virginia Tech, Blacksburg VA

PROJECT TECHNICAL REPRESENTATIVE (PTR):

Technical Support Division  
 Office of Surface Mining Reclamation and Enforcement

### Applied Science Information

NATIONAL TECHNOLOGY TRANSFER TEAM (NTTT) CONTACT:

Daniel Sammarco – [dsammarco@osmre.gov](mailto:dsammarco@osmre.gov)  
 (412) 937-2150