Title: **Effects of unseeded areas on species richness of coal mines reclaimed with municipal biosolids**			**December 2005**
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Technology Type:	Biosolids amendment	**Mine/Facility Type:**	Coal Mine
Study Scope:	Pilot	**Mine Name:**	not disclosed
Source:	Coal mine wastes	**Location:**	Clearfield County, Pennsylvania
Contaminant(s):	Metals, Cd, Cr, Cu, Ni, Pb	**Receiving Media:**	Soils/Sediments
Keywords:	grass competition; reclamation; species richness; waste recycling		

Abstract: Land application of municipal biosolids on coal mine spoils can benefit vegetation establishment in mine reclamation. However, the application of biosolids leads to domination by early-successional species, such as grasses, and low establishment of woody and volunteer species, thus reducing potential for forestry as a postmining land use. In this experiment, tree seedlings were planted in strips (0.6-, 1-, and 4-m wide) that were not seeded with grasses, and the effects of unseeded strip width on seedling growth and species richness were assessed. Planted seedling mortality was high; therefore, the effect of unseeded strip width on seedling growth could not be determined. However, it was found that natural plant invasion and species richness were highest in the 4-m unseeded strips. The practice of leaving 4-m-wide unseeded strips in mine reclamation with biosolids in the eastern United States, along with the improvement of tree seedling planting practices and planting stock, would help promote a more species-rich plant community that could be utilized for forestry or a variety of other postmining land uses.

For more information online: **http://www.blackwell-synergy.com/loi/rec?cookieSet=1**	**Contact:** **Jessica.halofsky@oregonstate.edu**

Reference

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Procedures

In the fall of 2000, the closed coal mine site was amended with biosolids in the form of dewatered sludge. The study site was then seeded with a grass mixture in 150 m long strips, alternating with unseeded strips of three different widths (0.6, 1, and 4 m). The experiment was set up as a randomized complete block design with three replications of each unseeded strip width. Tree seedlings were planted down the center of each unseeded strip, approximately 2 m apart. These unseeded areas were not mulched with straw after seedling planting to avoid introduction of other unknown species. A subsample of 30 seedlings of each species in each treatment was tagged, and the height of each individual was measured at the beginning and end of the first growing season. Percent vegetative cover of the seeded and unseeded strips was also assessed. Above ground biomass was collected and weighed from a randomly placed 1-m^2 quadrat in each unseeded strip and in three seeded strips three separate times in 2001. Soil samples were collected and analyzed for pH, available P, acidity, K, Mg, Ca, total N, CEC, and percent saturation of K, Mg, and Ca.

Results

Soil analysis showed that the pH of the study area was approximately 7.4, and the percent saturation of K, Mg, and Ca was 1.4, 13.3, and 85.2, respectively. The seeded strips had significantly higher percent cover than all of the other treatments (0.6, 1, and 4 m unseeded strips). Grasses in seeded strips had a higher relative density than the grasses in the unseeded strips, though this difference decreased in the second year of the study. In addition, unseeded strip width significantly affected percent vegetative cover. Seeded strips had significantly higher grass biomass than all other treatments, and the 0.6 m strip had significantly higher grass biomass than the 1 m strip. The seeded strips had significantly lower broadleaf biomass than all other treatments, in which mean broadleaf biomass ranged from 72.3 g/m^2 in the 0.6 m strip to 92.2 g/m^2 in the 1 m strip. In the second year of study, the 4 m strip had significantly higher broad leaf biomass than all other treatments (60.1 g/m^2), in which mean broadleaf biomass ranged from 0 g/m^2 in the seeded strip to 1.8 g/m^2 in the 0.6 m strip. In both years of study, the 4 m unseeded strip had the highest species richness (11 species in 2001, 23 in 2002), followed by the 0.6 m strip (nine species in 2001, eight in 2002), the 1 m strip (seven species in 2001, eight in 2002), and the seeded strip (three species in 2001, four in 2002). The number of volunteers in the 4 m strips was greater than in all other strip widths by the end of the study, most likely due to decreased levels of competition. Analysis reveals a negative relationship between strip width and the presence of *Dactylis glomerata* and *Agrositis gigantea*, and a positive relationship between strip width and *Digitaria sanguinalis* and *Polygonum* spp.

Conclusions

Of the treatments tested in this study, the 4 m unseeded strip width treatment comes closest to meeting the requirements of SMCRA. Planting grass species in strips, alternating with the 4 m width unseeded areas, provided site stabilization while still allowing the establishment of a volunteer plant species community that showed signs of succession (greater establishment of perennial and woody species). The practice of leaving 4 m wide unseeded strips in mine reclamation with biosolids would make forestry or the establishment of forests much more of a possibility than it is with current reclamation practices. In future studies, evaluating the effects of alternative grass species mixtures on volunteer invasion into unseeded areas may be useful, as would including a measure of species abundance or evenness in different treatment areas. In addition, experimentation with unseeded strips wider than 4 m could help determine whether this practice would be even more effective in increasing species richness and woody species survival on mine lands reclaimed with biosolids.