POWELL RIVER PROJECT
2005 Grant Report

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Environmental Science Class
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ABSTRACT

The Environmental Science students of the Region V Governor's School for Science and Technology participated in an annual research project at the Powell River Education Center located in Wise County, Virginia, during the summer of 2005. The study concentrated on the attributes of strip-mined soil to determine whether mine spoil soil quality is suitable for distinct post-mining activities without application of agrochemical or other land treatments. The test was conducted at three different locations within the Powell River Education Center boundaries. Soil sampling and horizon identification were developed at an undisturbed forest land site near the pavilion to serve as a control. Two other sites, which contain reclaimed mine soil, were chosen in an area below the orchard. One of these sites has been treated with municipal waste sludge.

The sampling was conducted within the soil horizon "A" at a depth of 15 cm below the surface, with sampling techniques applied to each soil pit. An average of the soil attributes from each location was established. A pit was constructed within an undisturbed forest, which will stand as a control. The soil at the other two locations was compared or contrasted with the soil taken from the undisturbed forest site. The soils at the reclaimed mine land sites were also compared and contrasted to results from previous years. The soil attributes at each location were compared to optimum soil attributes of representative plant needs.

This study shows the methodology and graphs of the facts collected by the Governor's School students during their research in 2005. The research establishes soil data for assessment and comparison purposes for investigations in future years.

This data will be made available to economic development groups, governmental agencies and active coal companies in southwest Virginia. This study will be a valuable resource for the Department of Agriculture, County Extension Agencies and other land management groups.

The Powell River Project is a cooperative research and educational effort devoted to the development of the economic resource potentials of southwestern

Virginia. The Powell River Project Center also provides a learning enrichment practice for the Region V Governor's School students that provide students with research opportunities to conduct studies on previously donated strip-mined land.

In the past, the Region V Governor's School students participated in an on-going study of the growth of Christmas trees on strip-mined land at the Powell River Project Site, located in Wise County, Virginia. Students conducted soil sampling, insect analysis, and dimensional characteristics of the trees.

In 2003, the Director proposed and received funding for the students in the Environmental group to conduct a research project entitled "Soil Attributes as the Powell River Site as Compared to Optimum Soil Characteristics." This study concentrated on soil attributes as compared to optimum soil characteristics for an assortment of post-mining land uses to determine whether mine spoil soil quality is suitable for distinct post-mining activities without application of agrichemical or other land treatments. This research will establish soil data for comparison purposes for future years of investigation. This study is a continuation of the project initiated in 2003.

Additionally, this year, the locations of the soil test sites were mapped using global positioning system (GPS) units. This will enable future studies to locate the test sites for future reference for studies at the same location and/or begin mapping for comparison to future locations.

INTRODUCTION

In Southwest Virginia, much of the land has been stripped of its natural resources. Establishing soil conditions that are favorable for plant growth in reclaimed strip mine soil is a major reclamation challenge. The purpose of this study was to collect and analyze soil data from three different locations at the Powell River Site. The five students of the Environmental Science class examined soil attributes at the three sites, using the forest site as a control, and compared them to representative optimal soil characteristics for post-mining land use. They did this to establish whether the quality of soil on the disturbed land is comparable to undisturbed forest soil and whether the soil in the disturbed areas is suitable for post-mining activities with no application of agrochemicals or other land treatments.

PROCEDURES

The Environmental Science class of the 2005 Region V Governor's School for Science and Technology gathered soil samples at the Powell River Project Center from three soil pits selected randomly at the site. One set of samples was collected from an undisturbed forest site near the pavilion. A second set of samples was collected from an untreated section of reclaimed mine soil near the orchard. The untreated soil consisted of only blended mine spoils. A third set of soil samples was collected from a section of reclaimed mine soil that had been treated with municipal sewage sludge. This section was also in an area near the orchard adjacent to the untreated site. Each of the three plots was sampled using sampling techniques and procedures described in the Soil Science Laboratory Manual for Community College Science Courses by Dr. Craig M. Ashbrook and the LaMotte soil analysis test kits. Samples were taken to determine whether soil nutrients and pH were at acceptable

levels in each plot. The Lamotte Soil Analysis Test Kit was used to determine the phosphorus, potassium, nitrogen and pH levels of the sample soil.
There were five students in the class, so each student ran tests on each of the three sites. Soil pits were dug at each of the three locations and each student took a sample of soil to be tested for primary nutrients (nitrogen, potassium and phosphorus) and pH. Soil density and porosity was not included in this year's study.

The samples were returned to the lab where the soil was analyzed using procedures described in the Soil Science Laboratory Manual for Community College Science Courses by Dr. Craig M. Ashbrook and the LaMotte Soil Analysis Test Kit.

Statistical analysis was conducted using 2 Sample T-test procedures. With this test, the null hypothesis (H_o) states that there are no statistical differences among the samples for a particular characteristic. Mathematically, if the alpha value is less than or equal to the p value in a set of data, the H_o is accepted. If the null hypothesis is rejected, then there is a significant difference between samples. The rejection of the H_o is a clear indicator that soil characteristics are impacting plant development (Ashbrook, 2002). An alpha value of 0.05 is used as the critical value for comparisons. Calculations were made using TI – 83 calculators.

This year, soil sampling sites were mapped using global positioning system (GPS) coordinates to record latitude, longitude and elevation of the soil samples.

SUMMARY OF DATA

SOIL ATTRIBUTES - NITROGEN

Testing of five soil samples each of undisturbed forest, untreated field, and sludge treated field at the Powell River Project Site showed no major statistical difference in the soil nitrogen levels. The average nitrogen level in the undisturbed forest was 10.0 lbs/acre. In the untreated field the average nitrogen level was 11.0 lbs/acre, and decreased to 10.8 lbs/acre in the sludge treated field.

Statistical analysis of the nitrogen tests, using the T-Test procedure, produced a P-value of 0.18 for treated soil compared to forest soil, 0.37 for untreated soil compared to forest soil, and 0.86 for treated soil compared to untreated soil. There was no statistical difference in the nitrogen levels of reclaimed mined land compared to the natural undisturbed forest land at the Powell River Site.

SOIL ATTRIBUTES – POTASSIUM

We found that the average potassium level of undisturbed forest soil was 100 lbs/acre. The untreated soil had an average potassium level of 116 lbs/acre. The potassium level in the treated soil was slightly higher, averaging 128 lbs/acre.

Statistical analysis using T-test procedures with an alpha value of .05 indicates that there is no significant statistical difference in the potassium levels of reclaimed mine land as compared to the natural undisturbed forest at the Powell River Site. T-test analysis produced a p-value of .18 compared to an alpha value of 0.05 for the average potassium soil levels in the treated mine soil when compared to forest soil. Comparing untreated mine soil to forest soil produced a p-value of 0.18. A p-value of 0.56 resulted when comparing the untreated mine soil to treated soil. This indicates

that there is no significant statistical difference between the potassium levels at these three sites.

Comparison of Soil Phosphorous Levels

There was no significant difference in the levels of the phosphorous tested from each of the sites. The group average for the five tests on the undisturbed forest soil was 9.6 lbs/acre. The group average for the treated soil was 20.0 lbs/acre. The group average for the untreated soil was 16.0 lbs/acre. The phosphorous level in the treated soil was higher than both the undisturbed forest and the untreated soil. The phosphorous level of the sludge treated soil was the highest of the three sites tested.

Statistical analysis using T-test produced a p-value of 0.16 compared to an alpha value of 0.05 for the average phosphorous levels in the undisturbed forest and untreated soils. There was no significant statistical difference between the phosphorous levels at these two sites. A p-value of 0.03 resulted from comparing the average phosphorous levels in the undisturbed forest and treated soils. A significant statistical difference was found between the phosphorous levels at these two sites. A p-value of 0.43 compared to an alpha value of 0.05 for the average phosphorous levels between the untreated and treated soils showed no significant statistical difference between the phosphorous levels at these two sites.

COMPARISON OF SOIL pH TEST

Three types of soil from the Powell River Project: forest soil, treated soil, and untreated soil were tested.

The average pH of undisturbed forest soil was 5.96. The average pH of treated soil was 6.46. The average pH for untreated soil was 5.90. The untreated soil was more acidic than the other sites.

Statistical Analysis Using T-Test Procedures with an Alpha Value .05 indicates that there is no statistical difference between the pH of the untreated reclaimed mine land site and the undisturbed forest site. However, there was a significant statistical difference between the treated reclaimed mine land site and the undisturbed forest soil.

T-Test comparison between forest and treated reclaimed mine land produced a p value of 0.01 compared to alpha value of .05. This indicates a significant statistical difference between the pH of forest soil and treated reclaimed mine land soil.

T-Test comparison between forest and untreated reclaimed mine land produced a p value of 0.86 compared to alpha value of .05. This indicates no significant statistical difference between the pH of forest soil and untreated reclaimed mine land soil.

T Test comparison between treated and untreated reclaimed mine land produced a p value of 0.13 compared to alpha value of .05. This indicates no significant statistical difference between the pH of treated and untreated reclaimed mine land soil.

LOCATION OF SOIL SAMPLING

Soil sample test sites were located in the Flat Gap Quadrangle using GPS units. GPS data was obtained using the NADRAD 1927 Contrus.

LOCATION	LATITUDE	LONGITUDE	ALTITUDE
FOREST	**N37^0 00” 38.1’**	**W82^0 40” 35.9’**	**2605 FT**
UNTREATED RECLAIMED MINE SOIL	**N37^0 00” 42.5’**	**W82^0 40” 51.5’**	**2568 FT**
TREATED RECLAIMED MINE SOIL	**N37^0 00” 42.5’**	**W82^0 40” 51.5’**	**2568 FT**

CONCLUSION

After testing the soil samples from the undisturbed forest, the untreated reclaimed mine soil, and the sludge treated reclaimed mine soil sites, our study found no significant difference in nutrient levels or pH in soils tested from undisturbed forest and reclaimed mine land except for phosphorus levels between the treated and untreated reclaimed soil and pH levels between the undisturbed forest land and the treated reclaimed mine soil. 2 sample t-test calculations showed that the phosphorus level was significantly higher in the treated soil as compared to the forest soil and the pH of the treated soil was significantly higher than the untreated soil.

The nutrient levels in the reclaimed mine land sites were similar enough to the forest site to suggest that the same type of vegetation that is found in the undisturbed forest should be viable in reclaimed mine land soil.

The pH of the untreated reclaimed soil was slightly lower than the pH of the forest soil. All pH levels were within optimum pH levels for most forest vegetation. Some selectivity in choosing plants for reseeding reclaimed mine land may be necessary due to the need for more specific pH levels for some plants.

Many trees and shrubs that are tolerant of acid conditions (including strongly acid conditions below pH 4.5) are available for Virginia landscapes. These plants may often be a better solution than attempting to adjust the soil to a higher pH, particularly where the native soil condition is by nature acidic. For the following trees and shrubs, check their hardiness and heat zone tolerances relative to their suitability for your particular area. Note that most trees and shrubs native to Virginia are adapted to at least slightly acid soils (http://www.ext.vt.edu/pubs).*

*See Charts pages 57 – 60.

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Comparison of Soil Attributes to Previous Years

Year	Attribute	Forest		Treated		Untreated	
2005	Nitrogen	10.0		11.0		10.8	lb/acre
2005	Potassium	100.0		128.0		116.0	lb/acre
2005	Phosphorus	9.6		20.0		16.0	lb/acre
2005	pH	6.0		6.5		5.9	
Year	Attribute	Forest		Treated		Untreated	
2004	Nitrogen	13.25	lb/acre	13.25	lb/acre	11.75	lb/acre
2004	Potassium	135	lb/acre	118.75	lb/acre	101.5	lb/acre
2004	Phosphorus	18	lb/acre	12	lb/acre	24	lb/acre
2004	pH	5.975		6.225		6.25	
2004	Bulk Density	1.033	g/ml	1.19	g/ml	1.686	g/ml
2004	Particle Density	2.106	g/ml	2.06	g/ml	2.21	g/ml
2004	Porosity	50.95	%	42.23	%	23.71	%
Year	Attribute	Forest		Treated		Untreated	
2003	Nitrogen	35.8	lb/acre	26.7	lb/acre	12.5	lb/acre
2003	Potassium	123.3	lb/acre	156.7	lb/acre	130	lb/acre
2003	Phosphorus	15	lb/acre	61	lb/acre	45	lb/acre
2003	pH	5.75		6.28		6.17	
2003	Bulk Density	1.06	g/ml	1.69	g/ml	1.64	g/ml
2003	Particle Density	1.83	g/ml	2.26	g/ml	2.7	g/ml
2003	Porosity	42.65	%	25.05	%	36.75	%
Year	Attribute	Forest		Treated		Untreated	
2002	Nitrogen	NA	lb/acre	NA	lb/acre	NA	lb/acre
2002	Potassium	NA	lb/acre	187.5	lb/acre	165	lb/acre
2002	Phosphorus	NA	lb/acre	76.25	lb/acre	115	lb/acre
2002	pH	NA		NA		NA	
2002	Bulk Density	NA		NA		NA	
2002	Particle Density	NA		NA		NA	
2002	Porosity	NA		NA		NA	

continued

Comparison of Soil Attributes to Previous Years

Year	Attribute	Forest		Treated		Untreated	
2001	Nitrogen	NA	lb/acre	50	lb/acre	25	lb/acre
2001	Potassium	NA	lb/acre	342.5	lb/acre	427.5	lb/acre
2001	Phosphorus	NA	lb/acre	200	lb/acre	68.75	lb/acre
2001	pH	NA		5.875		5.5	
2001	Bulk Density	NA	g/ml	NA	g/ml	NA	g/ml
2001	Particle Density	NA	g/ml	NA	g/ml	NA	g/ml
2001	Porosity	NA	%	NA	%	NA	%

Year	Attribute	Forest		Treated		Untreated	
2000	ALL	NA		NA		NA	

Year	Attribute	Forest		Treated		Untreated	
1999	Nitrogen	NA	lb/acre	45	lb/acre	15	lb/acre
1999	Potassium	NA	lb/acre	180	lb/acre	150	lb/acre
1999	Phosphorus	NA	lb/acre	148.3	lb/acre	68.75	lb/acre
1999	pH	NA		6.3		5.44	
1999	Bulk Density	NA	g/ml	NA	g/ml	NA	g/ml
1999	Particle Density	NA	g/ml	NA	g/ml	NA	g/ml
1999	Porosity	NA	%	NA	%	NA	%

NA - Not Available

Year	Attribute	Forest		Treated		Untreated	
1998	Nitrogen	NA	lb/acre	22.1	lb/acre	23.6	lb/acre
1998	Potassium	NA	lb/acre	240	lb/acre	264.5	lb/acre
1998	Phosphorus	NA	lb/acre	152.3	lb/acre	90	lb/acre
1998	pH	NA		5.9		5.7	
1998	Bulk Density	NA	g/ml	NA	g/ml	NA	g/ml
1998	Particle Density	NA	g/ml	NA	g/ml	NA	g/ml
1998	Porosity	NA	%	NA	%	NA	%

Year	Attribute	Forest		Treated		Untreated	
1997	Nitrogen	NA	lb/acre	17.3	lb/acre	17	lb/acre
1997	Potassium	NA	lb/acre	199	lb/acre	203	lb/acre
1997	Phosphorus	NA	lb/acre	127	lb/acre	56.7	lb/acre
1997	pH	NA		6.14		5.57	
1997	Bulk Density	NA	g/ml	NA	g/ml	NA	g/ml
1997	Particle Density	NA	g/ml	NA	g/ml	NA	g/ml
1997	Porosity	NA	%	NA	%	NA	%

NA - Not Available