

# THE PHYSIOLOGICAL CHARACTERISTICS TO ESTIMATE SPECIES POTENTIAL AS MINE RECLAMATION GROUND

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## Introduction

While it is clear that the use of native species is preferable, species must be regionally selected based on local species assemblages and site characteristics of the reclaimed mine.

There is an additional challenge in cases where reclaimed soils are contaminated with metals, are highly acidic or alkaline, or coarsely textured, such in the Bangka Belitung islands.

An anatomical and physiological evaluation of native tree species for tin mine reclamation on Bangka Belitung island concluded that predictions of the best adapted species were not those that showed the best performance in the field. Further study to determine which traits can best predict success

To test physiological characteristics that may be used to predict ground cover success on mine reclamation sites, fourteen herb and grass species were studied. All are widely available commercially within the SE United States, but not all have been widely adopted for reclamation.



Figure 1. Herbaceous plants for reclamation must be able to establish under a wide range of soil types, such those on a quarry site (left) and coal mined land (right).

## Material and Method

The experiment was carried out with fourteen herbs and grass species.

To test the influence of pH on germination, seeds were germinated at pH ranges of 5 – 10 in an incubator. Seeds were also sown in PVC pots on three different soil types: a vermiculite and quartz sand mixture, quarry overburden, and coal mine overburden. The plants were grown in the green house.



Figure 2. Seed germination and pot experiment

Plant height, cover and transpiration rates were measured throughout the investigation period. Leaf area and foliar pigment concentrations were measured at the end of the experiment.

Transpiration rate was measured using a LI-1600 chamber steady state porometer (LI-COR, USA). Leaf area was measured using a LI-3100 Area Meter (LI-COR, USA). Pigments were determined colorometrically (Bio-Mate 3, Thermo Scientific, USA) in ethanol extracts, using equations by Sesták et al. (1971) for chlorophylls a and b, and equation of Davies (1965) for carotenoids.

## Results and Discussion

Based on measured traits (Table 1) and historical useage, red clover (*Trifolium pratense* L.) and white clover (*Trifolium repens* L.) showed the greatest potential as ground cover for mined soils in the eastern United States.

Table 1. Summary of traits potentially desirable in reclamation ground covers: germination percentage, rapid early growth and establishment (% ground cover at 14 days), similar responses across soil type for germination, % cover, height, and transpiration rate, similar germination at a wide range of pH (no germ. x pH), and high foliar pigment concentrations.

	Germ >30%	Cover >50% at 14 days	No germ. x pH	No cover x soil type	No height x soil type	No transp. x soil type	Low transp. rate	Foliar pigment > 0.4 mg/g
<i>B. napus</i>	✓	✓				✓	✓	
<i>B. perviridis</i>	✓	✓	✓				✓	
<i>D. glomerata</i>			✓	✓		✓		
<i>H. esculentus</i>	✓	✓	✓			✓	✓	✓
<i>L. multiflorum</i>		✓	✓		✓	✓	✓	
<i>L. perenne</i>	✓		✓	✓				✓
<i>L. corniculatus</i>			✓	✓		✓	✓	✓
<i>P. virgatum</i>			✓	✓		✓	✓	
<i>P. fagopyrum</i>		✓	✓			✓		
<i>S. scoparium</i>			✓			✓		✓
<i>S. nutans</i>	✓		✓			✓		
<i>T. pratense</i>	✓	✓	✓	✓	✓	✓	✓	✓
<i>T. repens</i>	✓	✓	✓			✓	✓	✓
<i>V. unguiculata</i>		✓		✓		✓	✓	

Species with a moderate growth rate, which may be able to tolerate and persist in the variable and low-nutrient environment of reclaimed mines, are more likely to be adopted for widespread use.

As the use of native species increases, the adoption of species should be based in greater part on their site suitability and biological characteristics, and on their ability to promote the development of maximum ecosystem functionality.

## Conclusion

The preliminary results indicate that plant height and cover, transpiration rate, and foliar pigments may be used to predict plant adaptability to mined soil.

A field experiment is currently being conducted to monitor the growth performance of the clovers in the field, and which soil factors have the greatest influence.

## Acknowledgements

The first author (68150141) would like to thank Fulbright for funding the research. The Department of Forestry, Wildlife and Fisheries, Institute of Agriculture, University of Tennessee kindly provided facilities to us undertake the research. Universitas Bangka Belitung is thanked for its permission allowing the first author to conduct research out of the campus.

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