Sustainable Pasture Production on Reclaimed Coal Mine Soils

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Introduction Coal mining impacts large areas in the grasslands of the Mpumalanga Province of South Africa. To mitigate such impacts, it is imperative to restore the once productive soils to the best possible condition. The re-vegetation of mined land presents a particular challenge because cover soils are often acidic and nutrient deficient. It is current practice to amend such soils using lime and inorganic fertilizer. Research over the past 8-10 years into the use of a coal combustion by-product (CCB's)-class F fly ash, and an organic material such as sewage sludge, has demonstrated the feasibility of using such materials to amend acidic and infertile substrates (Norton *et al*., 1998; Truter and Rethman, 2002; Truter, 2007). The objective of this research was to determine if alternative amendments could create a more sustainable system, in which botanical composition, basal cover, plant productivity and soil chemical properties were improved.

Materials and methods A field trial was established in the year 2000 at an opencast coalmine in the Mpumalanga Province. These soils were amended with class F fly ash, a mixture of fly ash and sewage sludge, dolomitic lime and compared to the standard mine treatment (conventional lime and inorganic fertilisers) and a control (no treatment). Soils were re-vegetated with a mixture of Teff (*Eragrostis tef*), Rhodesgrass (*Chloris gayana*), Bermuda grass (*Cynodon dactylon*), Smutsfinger grass (*Digitaria eriantha*) and alfalfa (*Medicago sativa*). Botanical composition, basal cover, dry matter productions were all monitored seasonally.

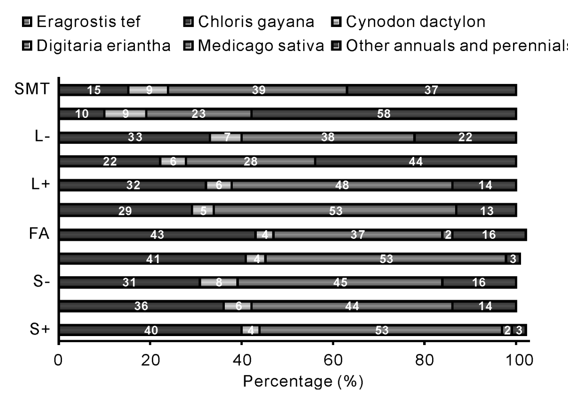

Figure 1 *Botanical composition on soils.*

Results and discussion The percentage basal cover and botanical composition of the past 7 years is given in Figure 1 and Table 1. It is evident from the observations that soils receiving a mixture of fly ash and sewage sludge (S) had a higher percentage of Rhodesgrass, and a higher production, whereas the control (no treatment) had a better biodiversity.

Table 1 *Percentage basal cover receiving different amendments.*

SEASON	FA	S	L	C	SMT
1999/2000	58^{C}_{a} (+/- 2.3)	46^{A}_{a} (+/- 1.4)	28^{AB}_{a} (+/- 0.9)	14^{C}_{a} (+/- 1.3)	34^{B}_{a} (+/- 1.6)
2000/2001	15^{A}_{d} (+/- 0.7)	12^{A}_{d} (+/- 0.8)	8^{AB}_{c} (+/- 0.7)	5^{C}_{a} (+/- 0.3)	10^{B}_{cd} (+/- 0.7)
2001/2002	15^{B}_{d} (+/- 0.6)	13^{B}_{d} (+/- 0.6)	7^{B}_{c} (+/- 0.2)	5^{D}_{c} (+/- 0.5)	9^{C}_{d} (+/- 0.4)
2002/2003	21^{B}_{c} (+/- 0.8)	19^{A}_{c} (+/- 0.7)	9^{B}_{bc} (+/- 0.4)	6^{D}_{bc} (+/- 1.0)	11^{C}_{c} (+/- 0.8)
2003/2004	22^{B}_{c} (+/- 0.7)	25^{A}_{c} (+/- 0.9)	9^{B}_{bc} (+/- 0.5)	7^{D}_{b} (+/- 0.3)	14^{C}_{c} (+/- 0.6)
2004/2005	27^{B}_{b} (+/- 0.8)	19^{A}_{c} (+/- 0.3)	11^{B}_{b} (+/- 0.3)	6^{D}_{bc} (+/- 0.6)	11^{C}_{c} (+/- 0.4)
2005/2006	29^{B}_{b} (+/- 0.9)	34^{A}_{b} (+/- 0.7)	12^{C}_{b} (+/- 0.4)	8^{D}_{b} (+/- 0.2)	21^{C}_{b} (+/- 0.8)
MEAN	***26.7***	***24.0***	***12***	***7.3***	***15.7***

Conclusions Results indicate that alternative ameliorants (fly ash and organic materials) can have marked beneficial effects, which is still evident after seven years, despite no fertiliser having been applied since the 1st season. This would appear to indicate that such ameliorants produce a more sustainable vegetation than the current practice.

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