The emergence and survival of *Digitaria eriantha* and *Chloris gayana* seedlings on mine tailings planted with coated and non-coated seed

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Introduction

The importance of vegetation in the process of rehabilitation and stabilisation of mined land is becoming more critical as the size of the affected areas and the impact on urban development increases. Successful establishment of vegetation on these areas are complicated by adverse physical and chemical properties of the growth mediums. These include; soil compaction, acidity, salinity and heavy metal contamination, extreme temperatures, low soil water contents and soil erosion (Oncel *et al.* 2000; Turner *et al.* 2006; Aken *et al.* 2007). Many of these soil/substrate conditions mentioned limit the establishment of vegetation from seed. Seed coating technologies have become a possible solution to address difficult seeding challenges to ultimately facilitate more successful establishment of vegetation in these hostile environments (Turner *et al.* 2006). From humble beginnings seed coating has developed into technologies that can be used to ameliorate the root zone to an extent by chemically changing the environment, aerating the root zone or by improving the seedlings health through the inoculation of seedling environment with beneficial micro-organisms (Harman 1991; Thrall *et al.* 2005; Turner *et al.* 2006). These specific attributes are not always clear and environmental specialists do not always know they have access to technologies that can change the micro-environment of a seedling.

Methodology

Phytotron studies at the University of Pretoria's Experimental Station were conducted to determine whether, and under which conditions, coated seed can assist in establishing a strong sward. Two species, *Digitaria eriantha* (Smuts finger grass) and *Chloris gayana* (Rhodes grass) were used to evaluate the efficacy of seed coating in growing conditions. Each species had two seed treatments, namely coated and non-coated and was planted in four growth mediums, namely a red sandy loam, gold tailings with <1% pyrite, gold tailings with >2% pyrite, and platinum tailings, described in Table 1.

Soil water content was manipulated by using field capacity (FC) (-0.03 MPa) as reference point, adding 25% more (125%) and 25% less water (75%), to create three soil water content treatments. The percentage of live seedlings was monitored over a period of 20 and 24 days for *D. eriantha* and *C. gayana*, respectively, to give an indication of germination percentage and survival likely in these growing conditions. This test was 10 days longer than the ISTA guidelines recommend for determining germination percentage for these species (ISTA 2006). Analysis of variance (PROC GLM) was done using SAS 9.2 software. Analysis was done within species and l.s.d.'s were significant at $P \leq 0.05$.

Results

The two species used in this research trial did not react in similar ways to the treatments. Gold tailings with <1% pyrite significantly inhibited the emergence of *D. eriantha*, while *C. gayana* proved to be more resilient to these conditions. These results are likely due to the high sulphate (SO_4-S) content of this growth medium. There were no differences observed between coated and non-coated treatments under the same conditions for both species tested. There were however differences between coated treatments in the different growth mediums. At 75% of FC, coated *D. eriantha* treatments in red sandy loam were lower than the coated treatments in platinum tailings ($P \leq 0.028$). In 125% of FC, there were significant differences between coated *D. eriantha* in gold tailings with >2% pyrite and the other growth mediums. These observations were not evident for the non-coated treatments.

Table 1. The growth medium properties from the soil analysis of the growth mediums red sandy loam, platinum tailings, Gold tailings with low pyrite content and high pyrite content.

Growth Medium	pH(KCl)	EC (mS/m)	SO4-S (mg/kg)	% sand	% silt	% clay
Red Sandy Loam	4.1	13.0	12.0	92.8	2.9	4.3
Platinum tailings	8.0	205.0	143.0	90.5	7.4	2.1
Gold tailings with <1% pyrite	5.3	193.0	1674.0	71.2	24.2	4.6
Gold tailings with >2% pyrite	6.4	422.0	447.0	86.1	11.8	2.1

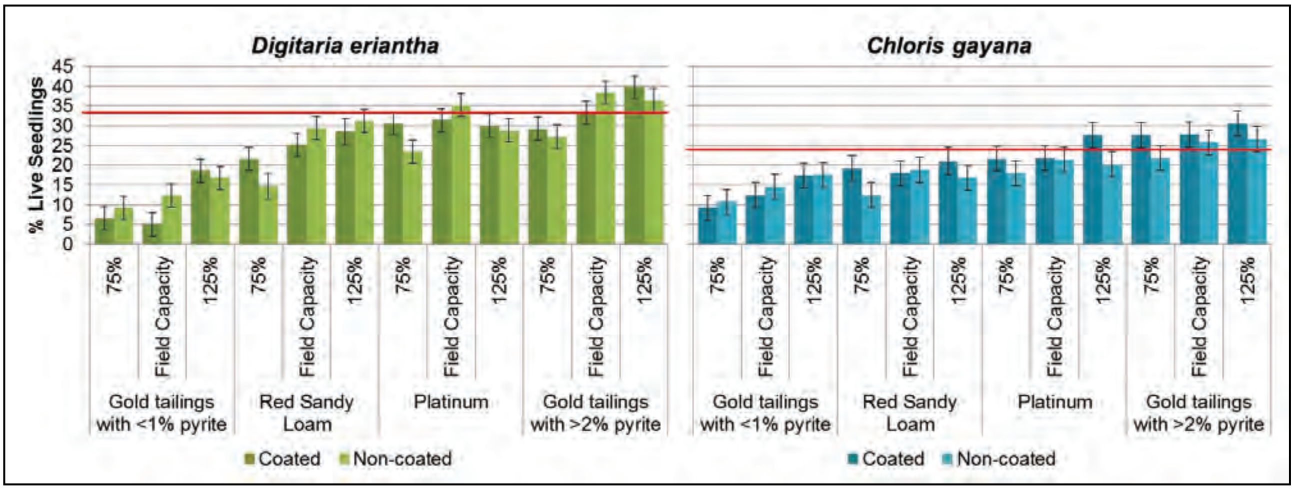

Figure 1. The maximum percentage live seedlings from coated and non-coated *Digitaria eriantha* and *Chloris gayana* during the period of observation for the different growth mediums, within a range of soil water content levels, field capacity (FC), 75% of FC, and 125% of FC. Red lines show germination % as reported by a seed test laboratory.

The effects of the coating in the growth mediums change with the soil water content levels. There were significant differences between the non-coated *D. eriantha* treatments with a soil water content of 75% of FC, compared with FC and 125% of FC in gold tailings with >2% pyrite and red sandy loam. This was not observed for coated treatments. *C. gayana* showed no statistical difference between soil water content treatments for both coated and non-coated treatments, however, it was evident that coated seed tended to perform better that uncoated seed in general, especially in the drier conditions (75% of FC).

Conclusion

The interaction between the available water, the growth medium characteristics and the seed coating can be significant. Gold tailings with <1% pyrite has a larger influence on emergence of *D. eriantha* than *C. gayana*. Understanding the interactions between the species characteristics, the seed coating constituents and the environment will help specialists in their coated seed recommendations to revegetate rehabilitated mined areas.

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