

The effects of seed ingestion by livestock, dung fertilization, trampling, grass competition and fire on seedling establishment of two woody plant species

Julius^{1*}, David Ward², Luthando Dziba³,

¹Agricultural Research Council, Pretoria, South Africa

²University of KwaZulu Natal, Pietermaritzburg, South Africa

³Council for Scientific and Industrial Research, Pretoria, South Africa

*Corresponding author e-mail: tjelele@arc.agric.za

Keywords: Dung nutrients, Seed scarification, Survival, Tree-grass seedling competition, Woody plant encroachment

Introduction

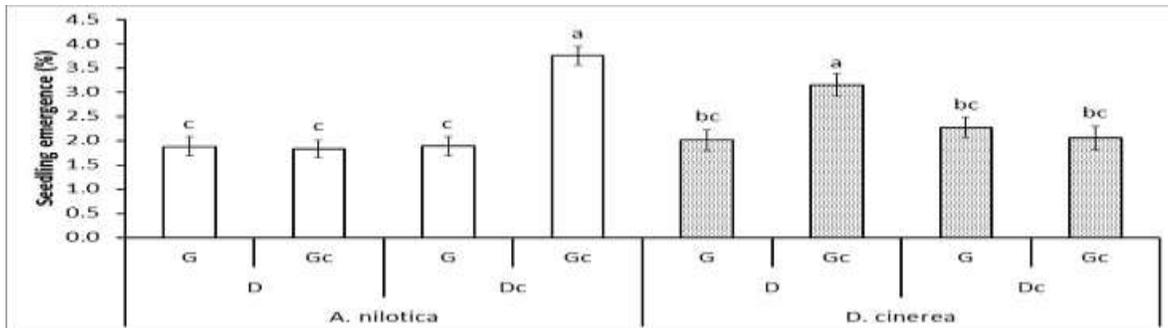
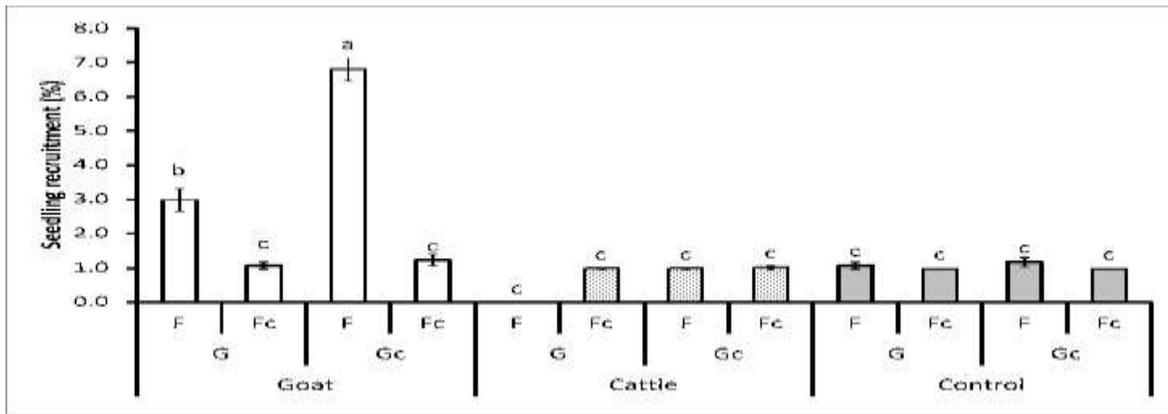
The increasing rate of woody plant encroachment in grasslands or savannas remains a challenge to livestock farmers. The causes and control measures of woody plant encroachment are of common interest, especially where it negatively affects the objectives of an agricultural enterprise. The objectives of this study were to determine the effects of gut passage (goats, cattle), dung (nutrients), fire, grass competition and trampling on establishment of *A. nilotica* (Fabaceae) and *D. cinerea* (Fabaceae sub family Mimosoideae) seedlings. Germination trials were subjected to: 1) seed passage through the gut of cattle and goats and unpassed/ untreated seeds (i.e. not ingested), 2) dung and control (no dung), 3) grass and control (mowed grass), 4) fire and control (no fire), 5) trampling and control (no trampling).

Materials and Methods

Field seedling emergence and seedling establishment: The experimental design consisted of 1 × 1 m plots, with 50 seeds per plot planted at 1 cm depth in the soil. All plots were separated by a 1 m buffer zone. The seedling emergence trial consisted of a completely randomized design with five factors replicated three times per treatment. These factors are: 1) passage through goats or cattle or unpassed/untreated seeds (i.e. not ingested), 2) dung and control (no dung), 3) grass competition and mowed grass, 4) fire and control (no fire), and 5) trampling and control (no trampling). Fifty *D. cinerea* seeds and 50 *A. nilotica* seeds retrieved from goats and unpassed/untreated seeds were planted per plot (50 *D. cinerea*, 50 *A. nilotica* and 50 unpassed/untreated seeds of each species were planted in separate plots) in three replicates with 16 combinations (96 plots and 4800 seeds). Another 50 *D. cinerea* seeds and 50 *A. nilotica* seeds retrieved from cattle and untreated seeds were planted per plot in three replicates with 16 combinations (96 plots and 4800 seeds). A total of 14400 seeds were planted in 192 plots for goats, 192 plots for cattle and 192 plots for controls (untreated seeds by passage through the gut of goats or cattle).

Results and Discussion

The interaction of animal species, grass and fire had an effect on seedling recruitment ($P < 0.0052$). Seeds retrieved from goats and planted with no grass and with fire ($6.81\% \pm 0.33$) had a significant effect on seedling recruitment than seeds retrieved from goats and planted with grass and no fire ($2.98\% \pm 0.33$; Fig. 1). Significantly more *D. cinerea* and *A. nilotica* seeds germinated following seed ingestion by goats ($3.59\% \pm 0.16$) than cattle ($1.93\% \pm 0.09$) and control or untreated seeds ($1.69\% \pm 0.11$; Fig. 2). Regardless of the relatively low seedling emergence and recruitment, the results showed that the direct and indirect effects of gut passage (Tjelele et al. 2014), grass competition (Grellier et al. 2012) and precipitation (Wilson and Witkowski 1998) were important in the recruitment of *D. cinerea* and *A. nilotica* seedlings, and may consequently contribute to woody plant encroachment.



Conclusion

Less dense grass cover, which resulted in reduced grass competition with tree seedlings for light, space and water, and improved seed scarification due to gut passage were vital for emergence and recruitment of *Acacia* seedlings. These results will contribute considerably to the understanding of the recruitment phase of woody plant encroachment.

References

- Grellier, S., S. Barot, J. Janeau and D. Ward. 2012. Grass competition is more important than seed ingestion by livestock for *Acacia* recruitment in South Africa. *Plant Ecol* 213: 899-908.
- Tjelele, T. J., D. Ward and L. E. Dziba. 2014. Diet modifies germination of *Dichrostachys cinerea* and *Acacia nilotica* seeds fed to ruminants. *Rangeland Ecology and Management* 67: 423-42.
- Wilson, T. B. and E. T. F. Witkowski. 1998. Water requirements for germination and early seedling establishment in four African savanna woody plant species. *Journal of Arid Environment* 38: 541-550.

Acknowledgement

The study was financed by National Research Foundation (NRF) and International Foundation for Science (IFS). We thank the following students: Marvin Mavhunga, Malose Matlou and Veronica Rakoeana and Rangelands Management personnel for their assistance during the experiment.