Title: Possible rehabilitation methods of abandoned croplands in the Cederberg Mountains, South Africa.

Authors: SAAYMAN, N., CUPIDO, C.F., BOTHA, J.C., SWART, R. & RHEEDER, C.G.


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Introduction

Large parts of the Succulent Karoo and Fynbos biome along the west coast of South Africa, including areas in the Cederberg Mountains, were used by farmers for cropping in the previous century in order to be self-sufficient and it provided an income. Taljaard (2008) found that after the government stopped subsidies to the farmers, cropping was no longer a viable option. Farmers therefore stopped planting crops, especially on the marginal lands. This caused large areas of land to lie fallow. Most of these lands are now dominated by mono-stands of the unpalatable, sometimes toxic, pioneer perennial shrub Galenia africana (Kraalbos; Allsopp 1999) with seed of desirable perennial species absent in the soil seed bank. These abandoned lands don’t contribute to the fodder supply for livestock or wildlife and when rehabilitated they can form corridors between natural areas which are important for the conservation of fragmented landscapes.

The objective of this study was to determine what rehabilitation methods and which indigenous perennial species are the most successful and economically feasible to rehabilitate old lands to a more productive state with a richer diversity.

Material and methods

Study area

The study was conducted in the Agterpakhuis region of the Cederberg Mountains on an old cropping land that was abandoned in 1992 and is now dominated by Galenia africana. It is situated in the Cederberg Sandstone Fynbos on the border with Doringrivier Quartzite Karoo (Mucina and Rutherford 2006). The area has an average annual rainfall of 196 mm, falling mostly in winter. The soils are sandy with a pH of 5.4 and an organic carbon content of 0.23%.

Treatments
A complete randomised block design was followed with eight (8) treatments and four (4) replicates. Each plot size was 10x10 m. The treatments were applied in May 2012 at the start of the rain season. The treatments were: seeding only (S), spade and seeding (SS), ripping and seeding (RpS), ploughing and seeding (PS), brush-cutting and seeding (BS), rolling and seeding (RS) and herbicide and seeding (HS). Species for re-seeding was: Grasses Chaetobromus involucratus subsp. dregeanus and Ehrharta calycina and dwarf shrubs Manochlamys albicans, Tetragonia fruticosa and Tripteris sinuata. The density of the re-seeded species and other perennial species were determined each year during October at the end of the rain season. The cost of each treatment was also determined. Analysis of variance (ANOVA) was performed on the data using PROC GLM procedure of SAS software Version 9.3 of the SAS System for Windows (SAS Institute, 2015).

Results and discussion

In 2012 the perennial species increased due to good germination by the re-seeded species, especially T. sinuata but these died back due to the dry summer of 2012/13. By 2014 less than 1% of the seeds that were sown in 2012 survived. Of the species sown, the grasses C. involucratus subsp. dregeanus and E. calycina did significantly better than the shrubs species (F = 4.74; p = 0.0016), with T. sinuata having the highest rate of establishment. It is necessary to supply seed of desirable perennial species as they are absent in the soil seed bank and dispersal from the adjacent natural areas is very slow. The species richness increased from four (4) perennial species encountered before the treatments were applied to 12 different perennial species found in 2014. The numbers of G. africana increased in 2013 after good winter rains in the undisturbed plots and their numbers remained high because of good summer rainfall. The plant density of the re-seeded species was significantly better in the ploughing and seeding (PS) and rolling and seeding (RS) treatments (F = 2.99; p = 0.0242) by 2014 and they had the highest species diversity. Ploughing is however a very drastic soil disturbance and we will not recommend it. These two treatments are also the most cost effective treatments with the cost of PS = R1.55/plant established and RS = R1.82/plant established. The costs were calculated with the assumption that the implements are available on the farm.

Conclusion and implications

Data for this study was severely limited by poor seedling establishment but we may deduce that soil disturbance is necessary for re-seeded species to establish and rolling with a knife roller may be the most practical method. However, additional work may be required to verify this finding. Re-seeding is necessary to supply seed to the soil seed bank and C. involucratus subsp. dregeanus, E. calycina and T. sinuata are recommended. Due to these actions the species diversity of the study area increased with more palatable perennial species present making more fodder available for animals. Rainfall is however the limiting factor. Because this may be a common scenario in this region it may be necessary to assess site conditions and seedling establishment after the initial seeding to determine if reseeding should be considered at the onset of the next rainy season.

References

