The restoration of bare patches in the Karoo: an evaluation of various techniques

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Introduction

The Great Karoo is an arid to semi-arid region of the inland, central and western parts of South Africa with an average annual rainfall of 100-600 mm increasing from the west to the east. Bare patches cover large areas of the Great Karoo. The surface soil of these bare patches is severely compacted, limiting moisture penetration. Perennial plants are rarely found in these areas (Louw 1992).

The development of large bare patches is usually the result of degradation processes, mainly severe overgrazing and patch selection (Kellner and Bosch 1992). Severe drought may also initiate the formation of such bare patches. The degradation of semi-arid regions may be rapid, but the recovery is slow due to low and variable rainfall, physical limitations to increasing soil moisture and depleted soil seed banks (van der Merwe and Kellner 1999; Wiegand, Milton and Wissel 1995; Call & Roundy 1991; Yeaton and Esler 1990).

The objective of this study was to identify and evaluate suitable methods for the revegetation of bare patches in the Karoo.

Study site

A bare patch, covering an area of approximately 100 ha, on the farm Hillmore near Beaufort West, was chosen as the study site. Hillmore is situated south east of Beaufort West and receives an average annual rainfall of 190 mm. The annual rainfall during the study period was 364 mm. The soils are clayey loam, with a very low organic carbon content of 0.2 %. However soil nutrient status is high, with sodium 60 mg/kg, phosphorous at 159 mg/kg and potassium 430 mg/kg.

Methods

Six different treatments were applied during November 1999. A randomised block design was followed in this study. The treatments were:

1) No treatment (Control) (C)
2) Oversowing (S)
3) Oversowing and covering with branches (SB)
4) Tilled to a depth of 100 mm (T)
5) Tilled and seed (TS)
6) Tilled, seed and branches (TSB)

Each of these treatments was applied in 20x20 m plots with 5 replications. Branches of nearby *Acacia karroo* trees were used for covering the necessary plots. A total of 15 kg seed/ha was broadcast onto the soil surface, after the tillage treatment had been applied, using a seed mixture comprising *Atriplex semibaccata, Cenchrus ciliaris, Chaetobromus dregeanus, Pteronia membranacea* and *Tripteris sinuatum.* All these seeds were obtained from the Worcester Veld Reserve.

Botanical composition (frequency data) was determined for each treatment plot during surveys conducted in July and November 2000. Ten quadrants of 1x2 m were placed in each plot and all the plants were counted and distinguished between reproductive and vegetative plants and seedlings on species level.

The data was statistically analysed using Two-way ANOVA, student-t tests and polar ordination.

Results and Discussion

Polar ordination of the data set (Figure 1) shows that the control and the TSB treatments had the smallest similarity in species composition following both the July and November botanical surveys. The greater the disturbance applied the greater the similarity in species composition among treatments. The SB-treatment of November was not included because it is an outlier.

The most common species in July and November include *Pentzia incana* and *Chaetobromus dregeanus, Lepidium africanum, Salsola calluna, Othonna sedifolia, Tagetes minuta, Atriplex lindleyi, Tripteris sinuata, Salsola kali, Sonchus oleraceus.* There were 49 different species present in July in the different plots and 30 different species in November. The soil seed bank consists of mainly annual weeds of which *Gnaphalium pensylvanicum*, was the most common

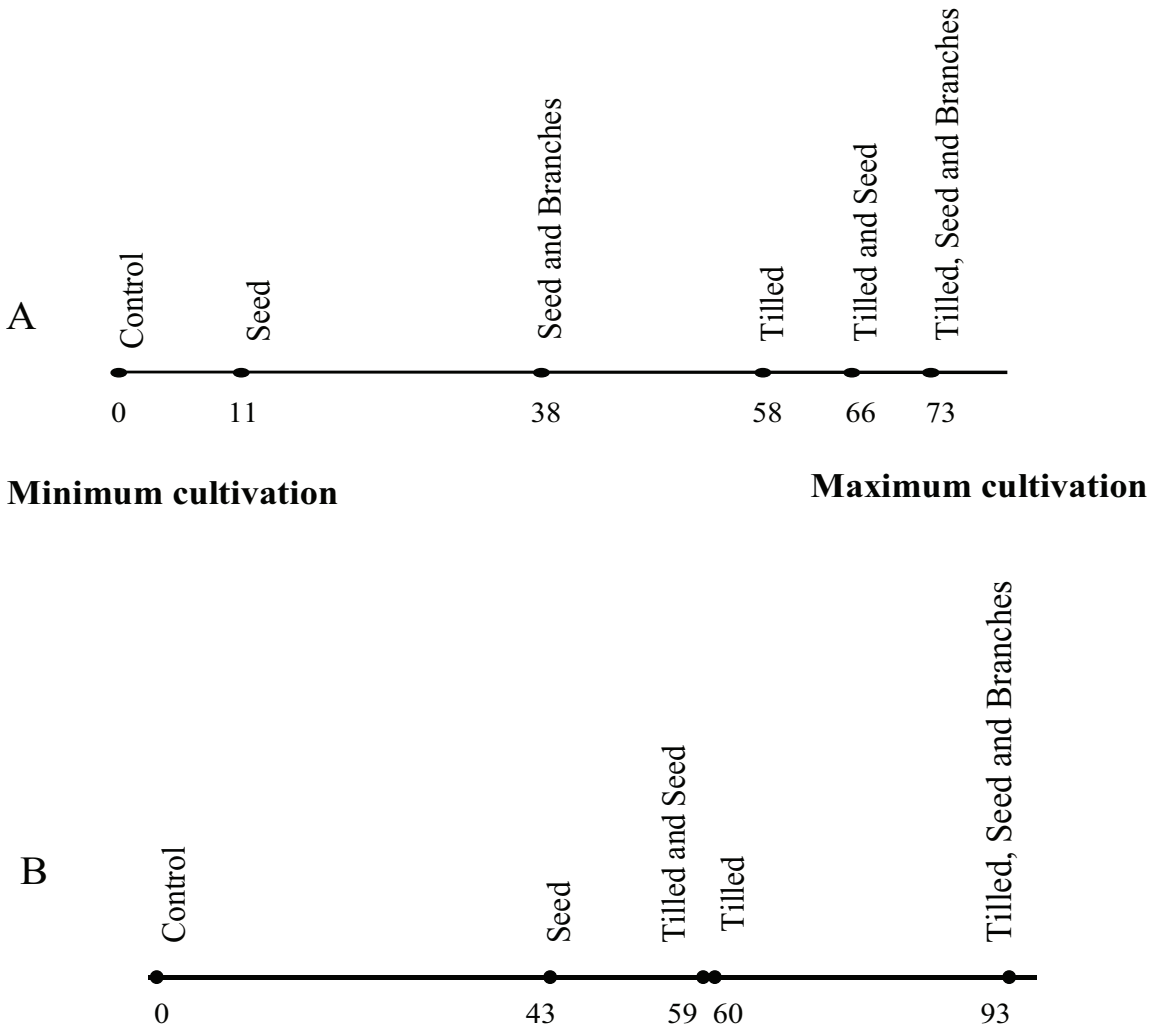

Figure 1: Polar ordination of the species composition of the different treatments in (A) July and (B) November 2000.

(Table 1).

Species	Hillmore
Lepidium bonariense	*
Hypochoeris radicata	*
Salvia sp.	**
Gnaphalium pensylvanicum	***
Gazania sp.	*
Oxalis sp	*
Creeping plant (maroon)	**
Species 1	*
Species 2	***
Species 3	*

Table 1: Species present in the soil seed bank on Hillmore

*** Many individuals
** Few individuals
* Very few individuals

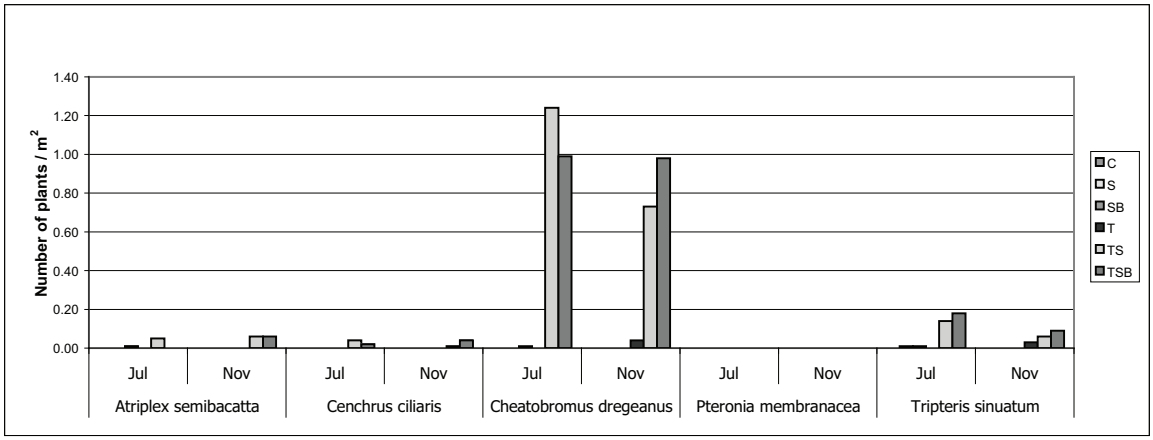

Figure 2: The density of the oversown species in the different treatments in July and November 2000.

The oversown species that show the best germination were *Chaetobromus dregeanus* and *Tripteris sinuatum*, although their numbers declined from July to November 2000. The best germination results were found in the TS and TSB treatments (Figure 2).

The Tilled-Seed-and-Branches treatment was the most successful, but also the most expensive (Esler and Kellner 2001). Tilled-and-Seed treatment was almost as successful, but will be much cheaper to apply, since it is not so labour intensive.

Conclusion

From the treatments applied in this study bare patches in the Karoo can be successfully revegetated. Success depends on ensuring either severe mechanical disturbance of the soil (cultivation of furrows to a depth of at least 100 mm) to increase water infiltration; or the provision of physical barriers (such as tree branches) to slow water movement across the soil surface, limit the effects of raindrops impact, reduce soil temperature, and act as a "catch" for wind-blown seed and organic matter or both. In addition viable seed of desirable species must be introduced where seed banks have been depleted.

Seeds of pioneer species such as *P. incana, Aridaria spp.* and *Galenia spp.* can also be oversown to provide a soil cover and a microhabitat for subclimax and climax species, like *C. dregeanus* and *T. sinuatum* to establish in.

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