Bush encroachment and related mitigation actions in the Molopo savanna of South Africa: implications for grass composition, forage production and grazing capacity

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Introduction

Bush encroachment
• thickening of undesired woody plants
• causes an imbalance in the grass: woody ratio and decrease of agricultural production
• 10 to 20 million ha of rangelands in South Africa have seen a decrease in carrying capacity due to bush encroachment (Ward, 2005)

Mitigation actions
• accelerate and assist in the regeneration of open savannas with a balanced co-existence of grass and woody plants
Study area

- Located within the North West- and Northern Cape Provinces of South Africa
- Vegetation: Molopo Bushveld (Rutherford et al., 2006)
- Rainfall: $\bar{\theta} 314.7$ mm a$^{-1}$
  CV 48%
- Geomorphology: Level, sandy plains
  Deep Arenosols
• 40 - 45% bush encroached of the Molopo (Richter et al., 2001);

• 82% decline in forage production and 80% decline in grazing capacity (Richter et al., 2001).
Mitigation actions

- **Rotational grazing**: Hand control for Aeroplane control.
- **Land tenure type**: Commercial and lease.
- **Animals**: Cattle and Game.
- **Treatment**: 2 weeks graze, 6 weeks rest. Stocking density of 10 ha.
- **Selective** treatment: Molopo granules (Tebuthiuron) applied every 5 years.
- **Non-selective** treatment: 2.5 – 3 kg ha⁻¹ Molopo (granules – Tebuthiuron) applied every 10 years.
- **No treatment**.

"Mitigation actions" text overlay on an image of a fence in a field.
Mitigation actions
Mitigation actions

4 years after hand selective treatment
Overview table

4 years after Aeroplane treatment
PCA

Principal Component Analysis

**Acaeri** – *Acacia erioloba*,
**Acamel** – *Acacia mellifera*,
**Bosalb** – *Boscia albitrunca*,
**Eraleh** – *Eragrostis lehmanniana*,
**Melrep** – *Melinis repens*,
**Schkal** – *Schmidtia kalahariensis*,
**Schpap** – *S. pappophoroides*
**Uromos** – *Urochloa mosambicensis*

**EC** – Electrical conductivity
**SOC** – Soil organic carbon
**Wphyto** – Woody phytomass
Treatment effects on woody phytomass (TE ha\(^{-1}\))

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Phytomass TE ha(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotational grazing</td>
<td>260.3 (a)</td>
</tr>
<tr>
<td>Hand control</td>
<td>248.3 (a)</td>
</tr>
<tr>
<td>Aeroplane control</td>
<td>200.3 (a)</td>
</tr>
<tr>
<td>No mitigation</td>
<td>1444.9 (b)</td>
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</tbody>
</table>
Treatment effects on grass forage production (kg ha\(^{-1}\))

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Grass forage production (kg ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotational grazing</td>
<td>2066.0 (a)</td>
</tr>
<tr>
<td>Hand control</td>
<td>1464.7 (b)</td>
</tr>
<tr>
<td>Aeroplane control</td>
<td>1797.4 (a,b)</td>
</tr>
<tr>
<td>No mitigation</td>
<td>381.2 (c)</td>
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</tbody>
</table>
Treatment effects on grazing capacity (ha LSU⁻¹)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Rotational grazing</th>
<th>Hand control</th>
<th>Aeroplane control</th>
<th>No mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grazing capacity (ha LSU⁻¹)</td>
<td>7.1 (a)</td>
<td>9.9 (a)</td>
<td>10.5 (a)</td>
<td>94.5 (b)</td>
</tr>
</tbody>
</table>
Relationship woody phytomass and forage production

\[ y = -0.876 + 5.3x \]

\[ r^2 = 0.851; p < 0.001 \]
Relationship woody phytomass and grazing capacity

\[ y = 1.148 - 1.739x \]

\[ r^2 = 0.84; \ p < 0.001 \]
Abundance patterns of grass functional groups

- **Perennial, palatable climax grass, largely grazing sensitive**
- **Perennial, palatable pioneer-subclimax grass, grazing tolerant**
- **Perennial, unpalatable climax grass, largely grazing tolerant**
- **Weak perennial, palatable pioneer-subclimax grass, grazing tolerant**
- **Weak perennial, unpalatable pioneer-subclimax grass, grazing tolerant**
- **Annual, unpalatable pioneer-subclimax grass, grazing tolerant**
Conclusions

- Bush encroachment greatly affects rangeland productivity;

- An 81.5% decline in forage production at woody plant densities of 1445 TE ha⁻¹;

- All three mitigation actions were effective;
Conclusion

• Hand control + rotational grazing best way for restoring productive and stable savannas?
  • Economically more expensive
  • Higher abundance of valuable grass and woody species (key resources)
  • Higher grazing/ browsing capacity
  • More balanced grass: woody ratio
  • Fertile islands
  • Aesthetical value
Acknowledgements

Farmers of the Molopo region

Extension Services of the Department of Agriculture and Rural Development in the North West Province
Thank you
References


Molopo 200 GG

- Active Ingredient = Tebuthiuron 200g kg$^{-1}$
- Molopo 200 GG is a highly active non-selective herbicide that works through root-uptake in plants;
- Exposure of even a small part of a plant root system to Molopo 200 GG, may cause severe plant injury or kill;
- The residual action of Molopo 200 GG in the treated area may be impaired if fire occurs within 36 months of application;
- Tebuthiuron is highly persistent in soil. Reported field half-lives are from 12 to 15 months in areas with over 1000 mm annual rainfall, with longer half-lives expected in drier areas or in soils with high organic matter content.