



Born to be a savanna tree

Effect of water, shade and competition with grass in tree germination



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Outline



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Methods

Preliminary Results

Some Conclusions

Introduction

Savannas: How can two very different life-forms (trees and grasses) coexist without one displace the other permanently?



A: Resources limitations and disturbances events

B: Apparently, tree seed germination and seedling establishment must be important to the long-term savanna dynamics

So, which factors are important for tree seed germination and seedlings establishment?

Tree-grass competition vs Windows of favorable conditions

(e.g. consecutive above-average rainfall years)



La : few experimental tests
Competition inhibition vs.



ations

Objective

To examine the effects of multiple factors (biotic and abiotic) that influence seed germination and seedling recruitment

This presentation:

Under what conditions tree seed germination increases?

Predictions:

Tree seed germination increases:

(1) in the absence of grass

(2) with higher resource availability
(water and shade)

Methods and Experiments

Field site at the

Southern African Wildlife College:

a c. 1 square Km fenced out area in
Timbavati Private Reserve (part of
Grater Kruger National Park)

Summer rainfall at SAWC:
450-550 mm per annum



Methods - Seed germination and early seedling establishment experiment



13 trees species - 8 Acacias species, *Brachistegia spiciformis*, *Colosporum mopane*, *Dicrostachys cinera*, *Jubernaria globiflora* and *Peltrophorum africanum*

12 weeks

Wet season: December 2008 – March 2009

8 Treatment combination

(20 seeds per species)

Water

Shade

Grass



Methods - Seed germination and early seedling establishment experiment

Experiment layout

	Water addition		Natural rainfall	
Shade	Grass +	Grass -	Grass +	Grass -
Full Sun	Grass +	Grass -	Grass +	Grass -



Results – Best models for overall germination

Species				Water	Water	Shade	Water
	Water	Shade	Grass	Shade	Grass	Grass	Shade Grass
<i>J. globiflora</i>	↑	↑	↑	*	*	*	*
<i>A. xanthophlea</i>	ns	ns	↓	ns	*	*	.
<i>B. spiciformis</i>	ns	↑	↑	.	ns	ns	.
<i>A. exuvialis</i>	↑	ns	↓	.	.	ns	.
<i>P. africanum</i>	ns	ns	↓	.	.	ns	.
<i>A. nilotica</i>	↓	↓	↓	ns	*	.	.
<i>A. tortolis</i>	↑	↑	↓	.	.	.	.
<i>A. nigrescens</i>	↑	↑	ns	.	.	.	.
<i>D. cinera</i>	↑	↑	ns	.	.	.	.
<i>A. karoo</i>	↑	.	.	.	.	.	.
<i>A. gerardii</i>	.	.	.	.	.	.	.
<i>A. sieberiana</i>	.	.	.	.	.	.	.
<i>C. mopane</i>	.	.	.	.	.	.	.

General Linear Models

Water:

1 negatively affected
6 positively affected
6 not affected

Shade:

1 negatively affected
5 positively affected
7 not affected

Grass:

5 negatively affected
2 positively affected
6 not affected

↑ **Positive effect**

↓ **Negative effect**

* **Significant interaction**

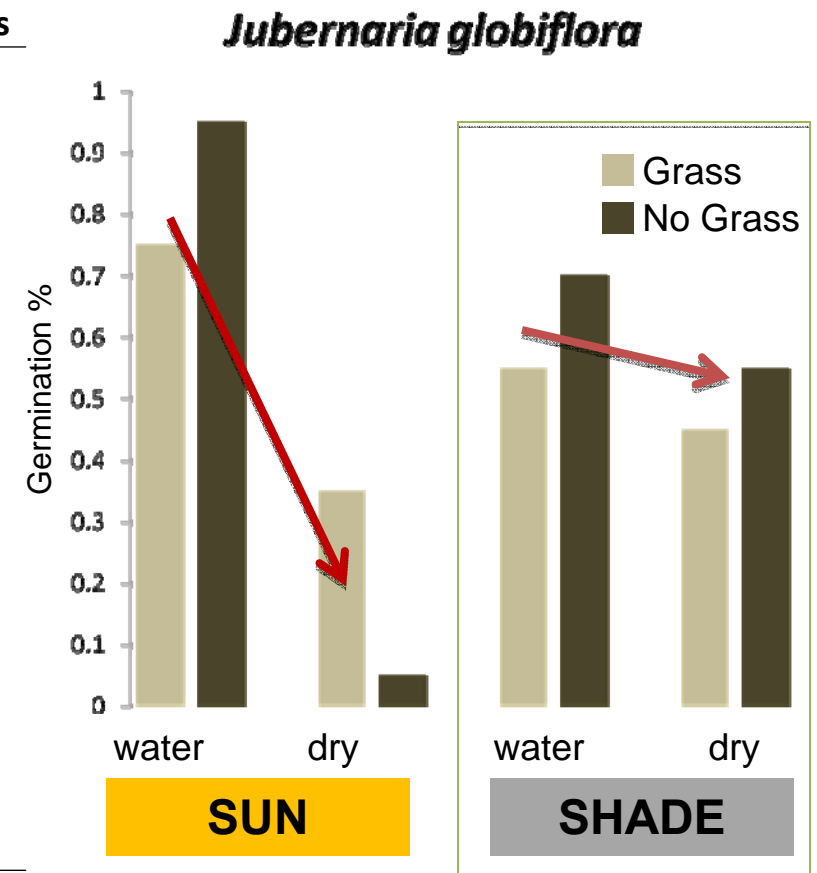
ns **Not Significant**

. **Not on the model**

Different species have different requirements

Results – Best models for overall germination

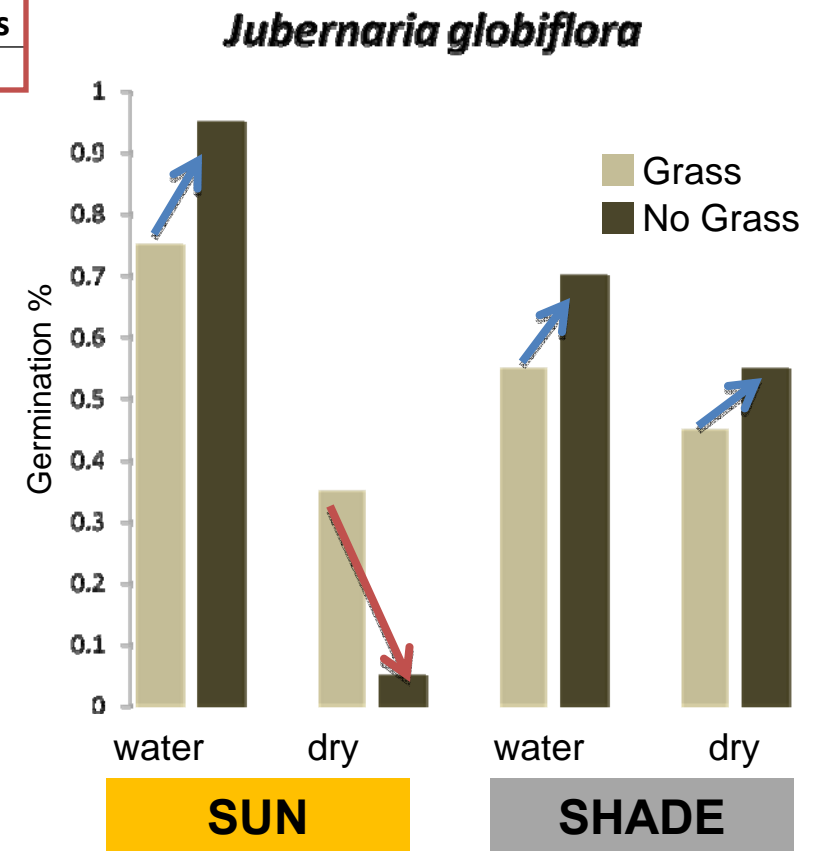
Species	Water	Shade	Grass	Water Shade	Water		
					Water Grass	Shade Grass	Shade Grass
<i>J. globiflora</i>	↑	↑	↑	*	*	*	*
<i>A. xanthophlea</i>	ns	ns	↓	ns	*	*	
<i>B. spiciformis</i>	ns	↑	↑		ns	ns	
<i>A. exuvialis</i>	↑	ns	↓			ns	
<i>P. africanum</i>	ns	ns	↓			ns	
<i>A. nilotica</i>	↓	↓	↓	ns	*		
<i>A. tortolis</i>	↑	↑	↓				
<i>A. nigrescens</i>	↑	↑	ns				
<i>D. cinera</i>	↑	↑	ns				
<i>A. karoo</i>	↑						
<i>A. gerardii</i>							
<i>A. sieberiana</i>							
<i>C. mopane</i>							



Shade buffers the effect of water stress

Results – Best models for overall germination

Species	Water	Shade	Grass	Water Shade	Water Grass	Shade Grass	Water Shade Grass
<i>J. globiflora</i>	↑	↑	↑	*	*	*	*
<i>A. xanthophlea</i>	ns	ns	↓	ns	*	*	
<i>B. spiciformis</i>	ns	↑	↑		ns	ns	
<i>A. exuvialis</i>	↑	ns	↓			ns	
<i>P. africanum</i>	ns	ns	↓			ns	
<i>A. nilotica</i>	↓	↓	↓	ns	*		
<i>A. tortolis</i>	↑	↑	↓				
<i>A. nigrescens</i>	↑	↑	ns				
<i>D. cinera</i>	↑	↑	ns				
<i>A. karoo</i>	↑						
<i>A. gerardii</i>							
<i>A. sieberiana</i>							
<i>C. mopane</i>							

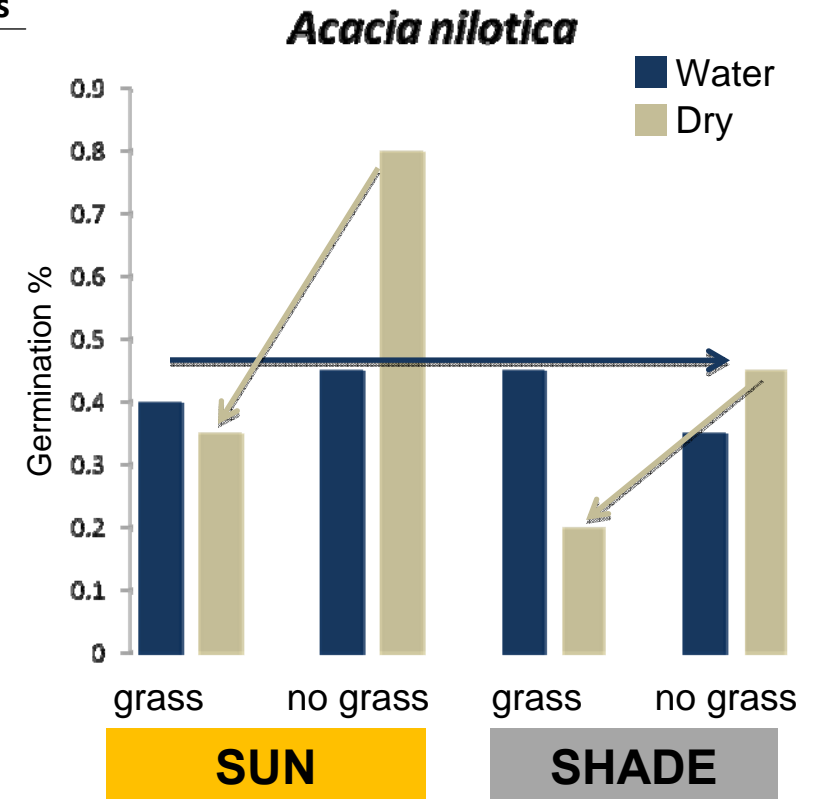


In harsh environmental conditions (e.g. droughts) grass is beneficial for seed germination

“ GRASS IS COOL ”

Results – Best models for overall germination

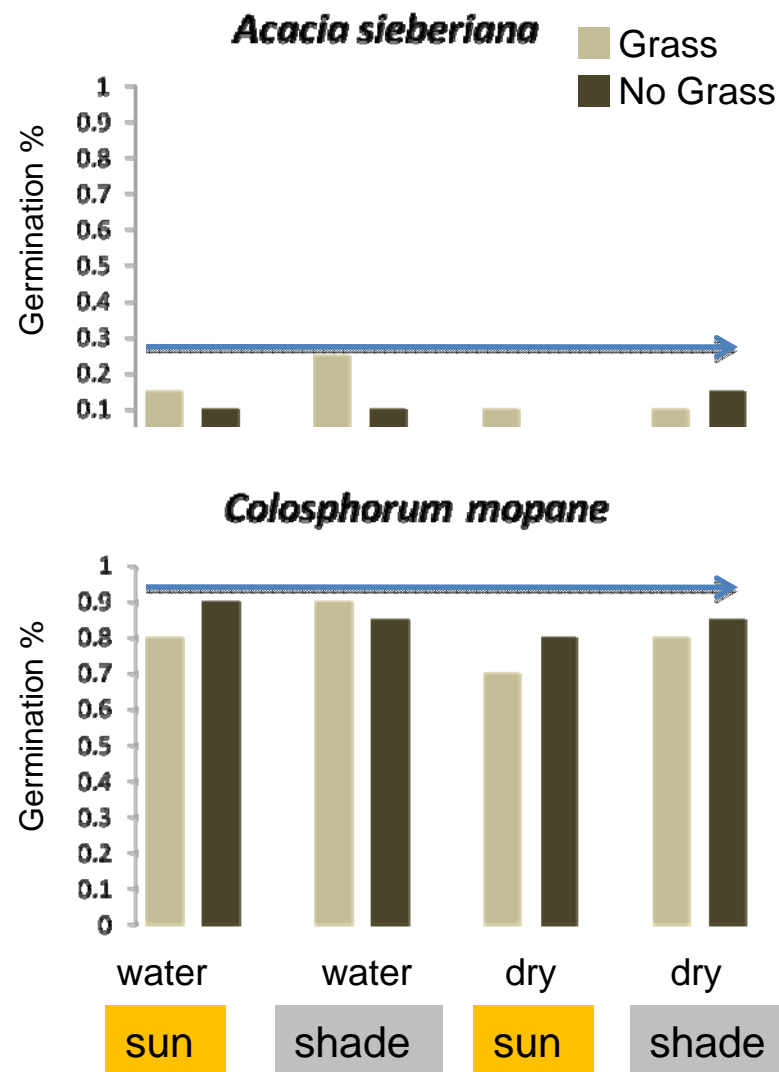
Species	Water	Shade	Grass	Water			
				Shade	Water Grass	Shade Grass	Shade Grass
<i>J. globiflora</i>	↑	↑	↑	*	*	*	*
<i>A. xanthophlea</i>	ns	ns	↓	ns	*	*	
<i>B. spiciformis</i>	ns	↑	↑		ns	ns	
<i>A. exuvialis</i>	↑	ns	↓			ns	
<i>P. africanum</i>	ns	ns	↓			ns	
<i>A. nilotica</i>	↓	↓	↓	ns	*		
<i>A. tortolis</i>	↑	↑	↓				
<i>A. nigrescens</i>	↑	↑	ns				
<i>D. cinera</i>	↑	↑	ns				
<i>A. karoo</i>	↑						
<i>A. gerardii</i>							
<i>A. sieberiana</i>							
<i>C. mopane</i>							



The negative effect of grass on *A. nilotica* seed germination only occurs in dry conditions

Results – Best models for overall germination

Species	Water	Shade	Grass	Water			
				Shade	Grass	Shade	Grass
<i>J. globiflora</i>	↑	↑	↑	*	*	*	*
<i>A. xanthophlea</i>	ns	ns	↓	ns	*	*	
<i>B. spiciformis</i>	ns	↑	↑		ns	ns	
<i>A. exuvialis</i>	↑	ns	↓			ns	
<i>P. africanum</i>	ns	ns	↓			ns	
<i>A. nilotica</i>	↓	↓	↓	ns	*		
<i>A. tortolis</i>	↑	↑	↓				
<i>A. nigrescens</i>	↑	↑	ns				
<i>D. cinera</i>	↑	↑	ns				
<i>A. karoo</i>	↑						
<i>A. gerardii</i>							
<i>A. sieberiana</i>							
<i>C. mopane</i>							



***A. sieberiana* has low germination in any conditions, while *C. mopane* germinates in any kind of conditions**

Conclusions

Under what conditions do tree seeds germinate better?

Predictions:

Tree seed germination increases:

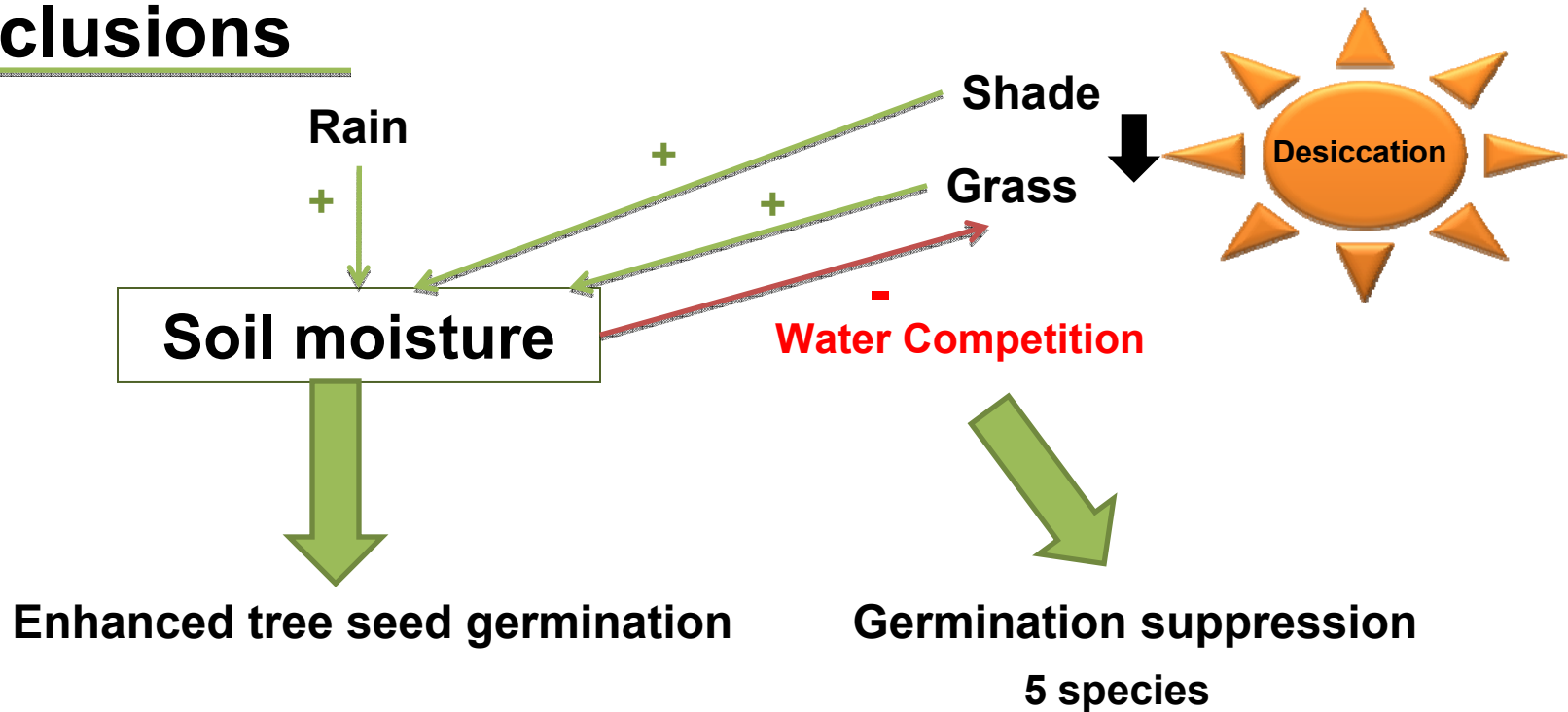
(1) in the absence of grasses

Grass does not always restrain tree seed germination

(2) with higher resource availability
(soil moisture and shade)

High resource availability does not always benefit tree seed germination

Conclusions



Different species have different requirements



Environmental conditions variation is essential to maintain the balance between species

What about seedling recruitment?

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