

# Interference potential of the alien invasive plant *Parthenium hysterophorus*

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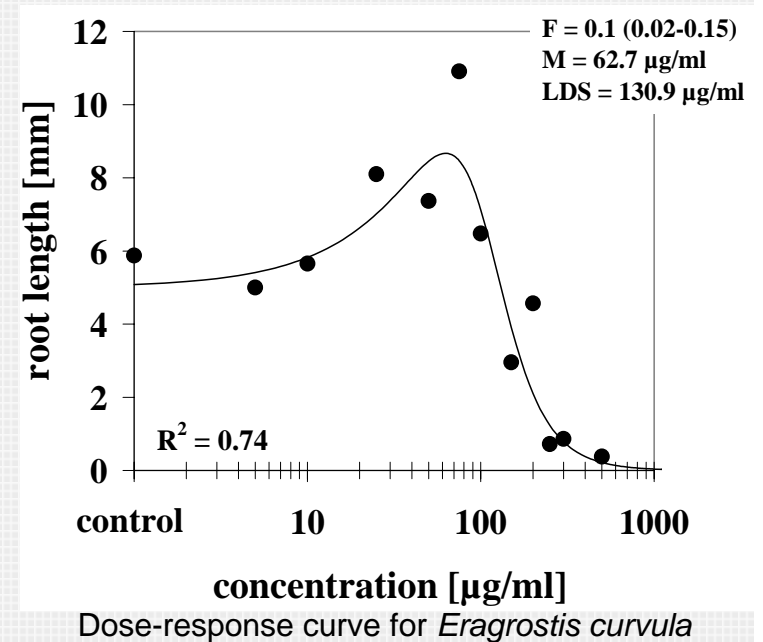
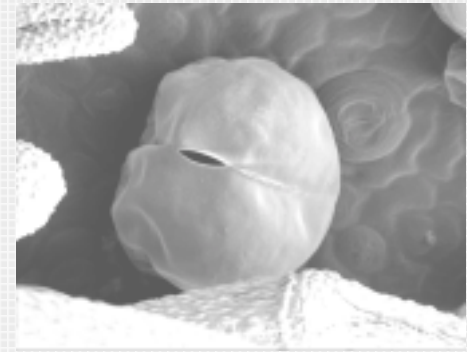
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# Previous work

- Location of parthenin in capitate-sessile trichomes (0.3  $\mu\text{g}$  parthenin)
- Root growth response of test species to parthenium leaf extracts/pure parthenin
- Parthenin observed to account for up to 100% of phytotoxicity



**Field trial: Interference potential of *P. hysterophorus* with indigenous grass species in the KNP**



- Objective: Study the interaction between parthenium and three indigenous grass species

Grass species:            *Eragrostis curvula*  
                                  *Panicum maximum*  
                                  *Digitaria eriantha*

Parthenium infestation levels:  
                                  0 (control)  
                                  5 plants m<sup>-2</sup>  
                                  7.5 plants m<sup>-2</sup>

Replications: 3 (CRD)

Dry mass accumulation of interacting species monitored

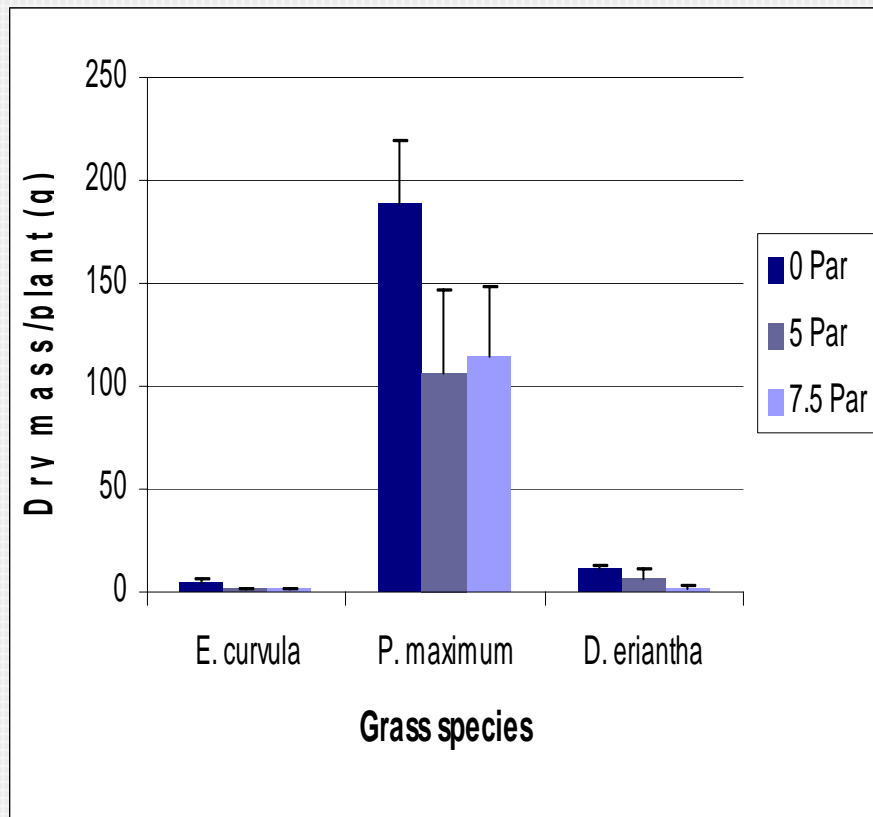


18 January 2004

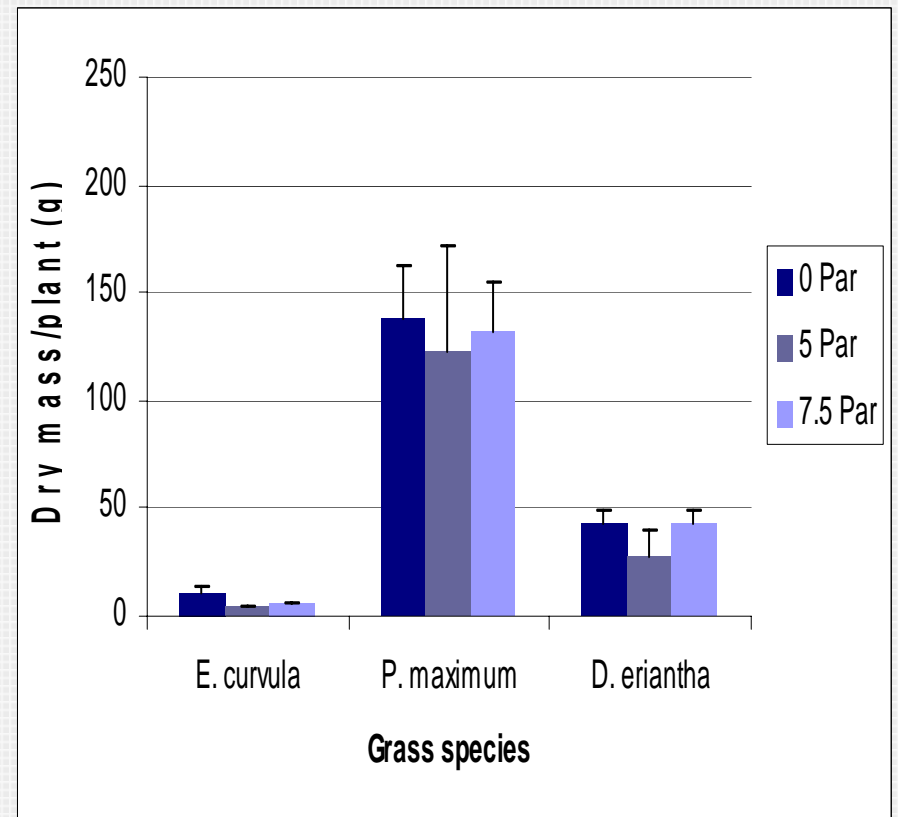


31 March 2004

# Grass dry mass accumulation



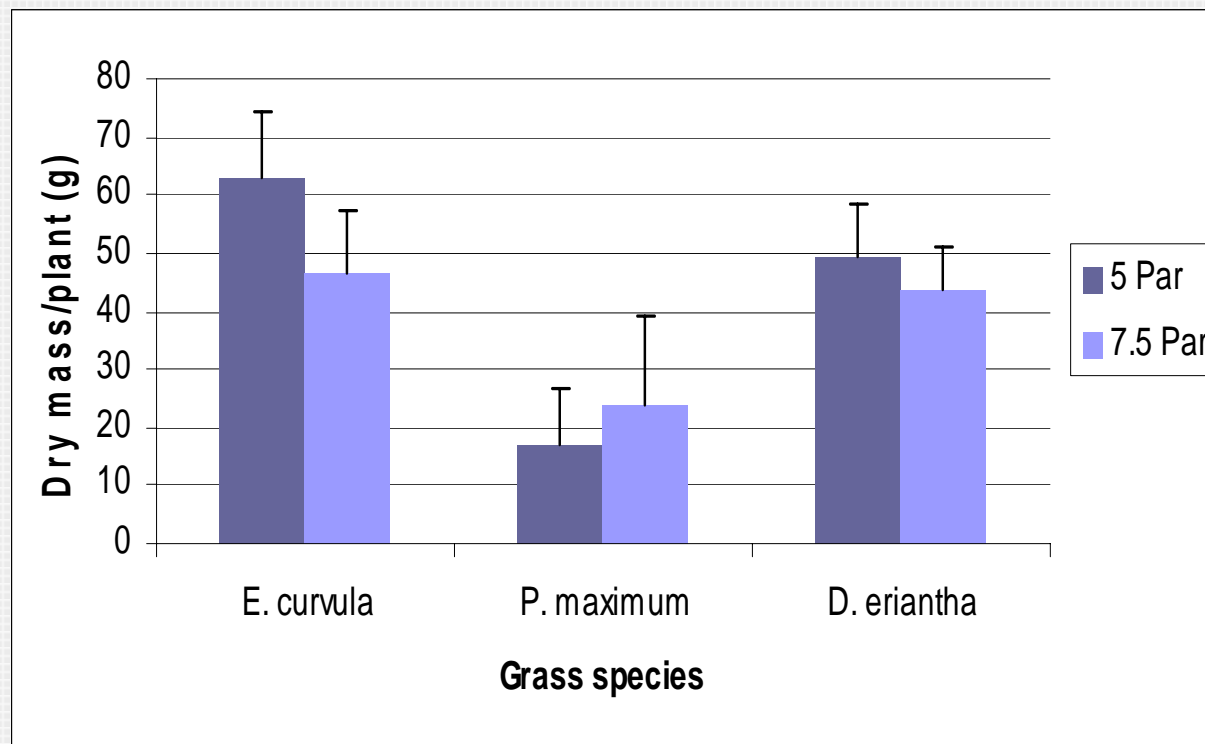
2003/2004



2004/2005

# Parthenium dry mass accumulation

2003/2004



# Parthenium dry mass accumulation

## 2004/2005

<u>Parthenium density</u>	Plant species			
	<i>P. hysterophorus</i>	<i>E. curvula</i>	<i>P. maximum</i>	<i>D. eriantha</i>
5 plants m <sup>-2</sup>	32.3d	22.0b	0.23f	9.7a
7.5 plants m <sup>-2</sup>	14.5e	12.2c	3.2f	7.2a

Means followed by different letters differ significantly (Tukey –test, P=0.05)

# Conclusions

- *P. maximum* resisted the interference effect from parthenium and suppressed its growth significantly
- Parthenium growing on *P. maximum* plots observed to be stunted and produce less seed, mortalities in many cases
- *E. curvula*, *D. eriantha* not well suited to field trial conditions
- *P. maximum* displays potential as an antagonistic species



9 February 2006



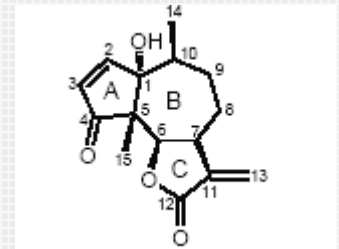
15 March 2004



14 March 2006

# Laboratory studies

1. Production dynamics of parthenin
2. Soil degradation of parthenin
3. Sensitivity of indigenous grass species to pure parthenin



Chemical structure of parthenin

## Objective 1:

Study the production dynamics of parthenin over the life-cycle of *P. hysterophorus*

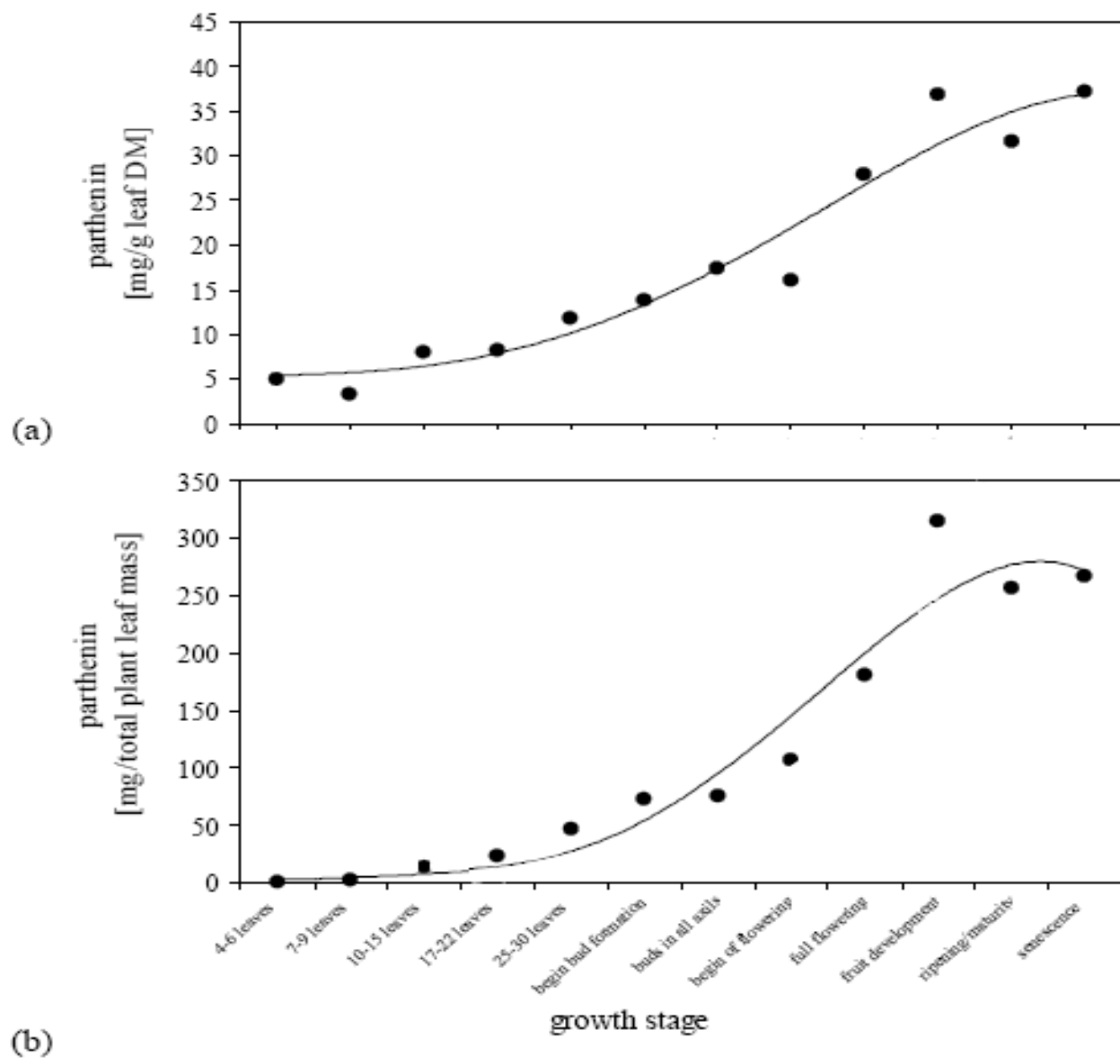


Fig. 1: (a) Parthenin concentration in dry leaf mass (DM), and (b) total parthenin content in total leaf dry mass of a single plant at different growth stages of *Parthenium hysterophorus*.

# Selected characteristics of *P. hysterophorus* plants at different growth stages

Growth stage	Mean water content [% of FM]	Total number of leaves	Total FM of leaves [g]	Total DM of leaves [g]	FM of entire plant [g]	Plant height [cm]	Parthenin [mg g <sup>-1</sup> leaf DM]
4-6 leaves	88.6±1.6	5.4	1.3	0.2	1.4	8.3	2.94 d
7-9 leaves	86.0±4.3	7.6	4.2	0.6	4.7	13.1	3.41 d
10-15 leaves	89.7±1.1	11.8	16.8	1.7	19.9	22.5	6.58 dc
17-22 leaves	89.1±1.2	19.0	26.6	2.9	31.6	26.8	6.97 dc
25-30 leaves	87.2±2.6	27.8	35.8	4.6	43.6	27.4	11.10 bc
begin of bud formation	86.5±3.6	27.6	40.5	5.5	53.2	35.6	12.59 abc
buds in all axils	84.9±3.4	40.7	31.6	4.8	50.5	48.0	16.13 abc
begin of flowering	84.8±4.3	44.8	45.0	6.8	67.4	50.3	14.53 abc
full flowering	80.5±3.5	77.3	38.4	7.5	86.0	83.0	25.85 ab
Fruit development	77.0±2.6	146.3	48.6	11.2	148.1	124.3	34.33 a
ripening/maturity	64.8±7.5	164.5	23.1	8.1	115.4	112.5	29.15 ab
Senescence	20.3±0.0	77.0	9.7	7.7	85.9	125.5	34.7 a

Means followed by different letters differ significantly (Tukey –test, P=0.05)

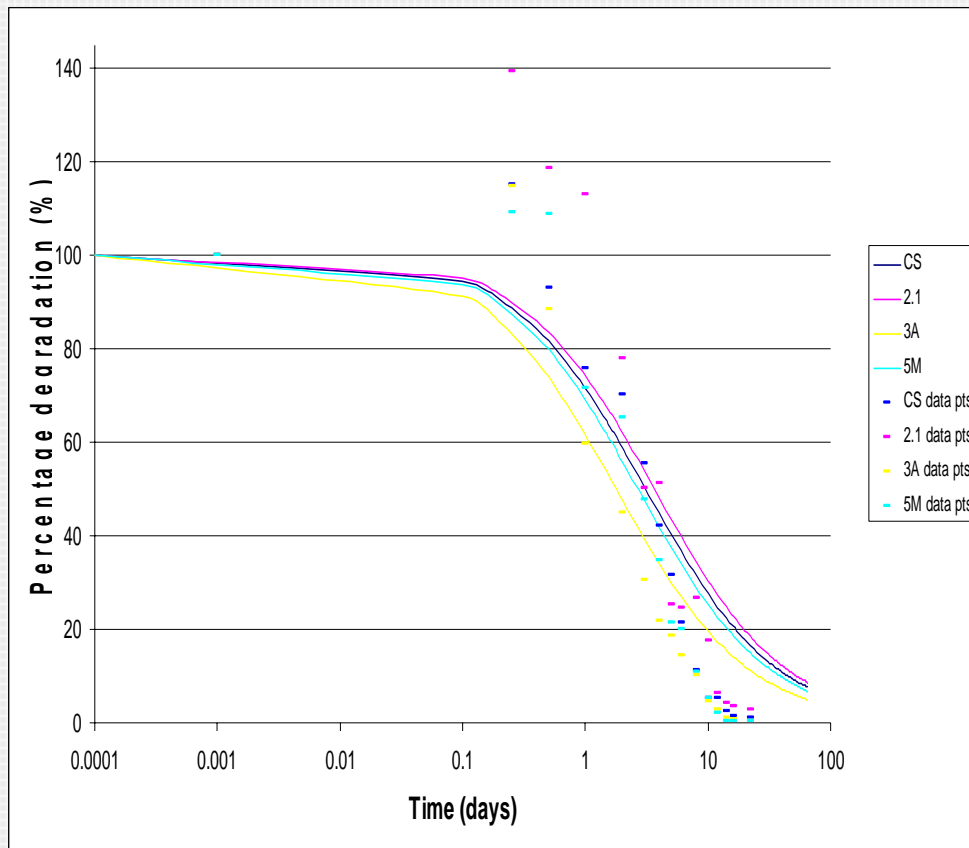
# Conclusions

- High resource allocation priority
- May indicate residual allelopathy strategy to inhibit/impede recruitment of other species

## Objective 2:

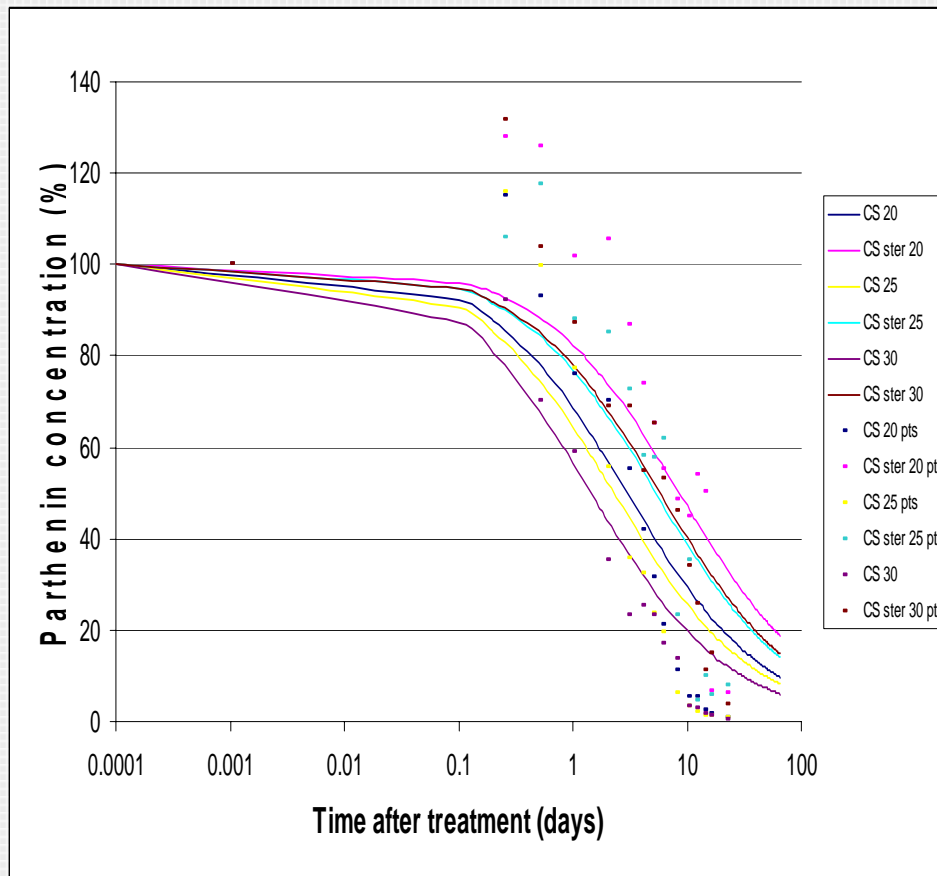
Study the degradation of parthenin in different soil types and under different temperature regimes

# Parthenin degradation in different soil types



Soil type	DT <sub>50</sub> (days)
Loam	1.78a
Sandy loam	2.67ab
Very loamy sand	3.10b
Sand	3.64b

# Degradation of parthenin in sterilized and non-sterilized compost soil incubated at temperature regimes of 20, 25 or 30°C



Soil Treatment	DT <sub>50</sub> (days)
CS 20°C <i>Sterile</i>	8.54e
<i>Non-sterile</i>	2.98bc
CS 25°C <i>Sterile</i>	5.32cd
<i>Non-sterile</i>	2.29b
CS 30°C <i>Sterile</i>	5.78d
<i>Non-sterile</i>	1.44a

# Conclusions

- Parthenin readily degradable in soil
- Temperature significant
- Microbial degradation evident

## Objective 3:

Study the sensitivity of the three indigenous grass species to parthenin

# Phytotoxicity of pure parthenin

Species	ED <sub>50</sub> (µg ml <sup>-1</sup> )	
	Radicle length	Germination
<i>E. curvula</i>	212.9a	345.9a
<i>D. eriantha</i>	144.7b	184.2b
<i>P. maximum</i>	100.6c	96.1c

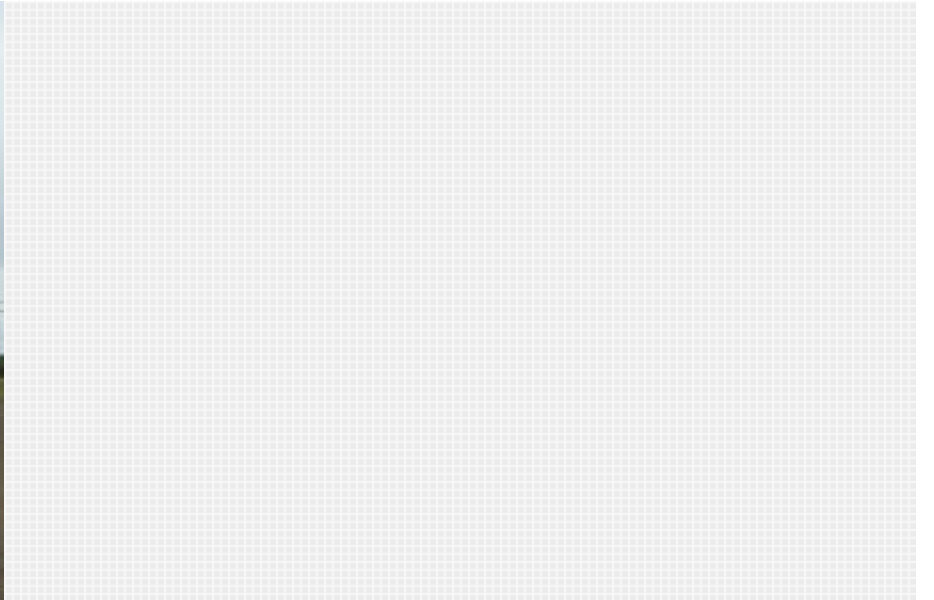
Means followed by different letters differ significantly (Tukey –test, P=0.05)

# Conclusions

- Confirmation of allelopathic effect on all three grasses
- Species vary in sensitivity to parthenin
- Establishment of *P. maximum* in parthenium stand may be challenging

# Work in Progress

- Parthenin detection/degradation studies using soil from KNP
- Long-term monitoring of invasiveness of *P. hysterophorus* in the KNP (Crocodile Bridge area)



# Acknowledgements

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