

# WATER USE AND SUITABILITY OF JATROPHA CURCAS AS A BIOFUEL FEEDSTOCK

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# Background

- Since 2005 increasing interest in biofuel development within southern Africa.
- Key driver potential to boost rural development and energy security.
- *Jatropha curcas* in particular captured attention of developers as a wonder biofuel crop with many projects being established in Mozambique, Swaziland, Zambia, Tanzania, and Namibia.



## ***Jatropha curcas* - Claims**

- Low water-use
- Growth on marginal and degraded lands
- Potential energy crop – high oil yields after 2-3 yrs.
- Low maintenance (labour costs)
- Disease tolerance / pest resistance



# South African Situation



SA in 2007 placed a moratorium on the planting of *Jatropha* due to fears of:

1. Excessive water use
2. Alien invasiveness and
3. Lack of knowledge on its' economic potential (yield)

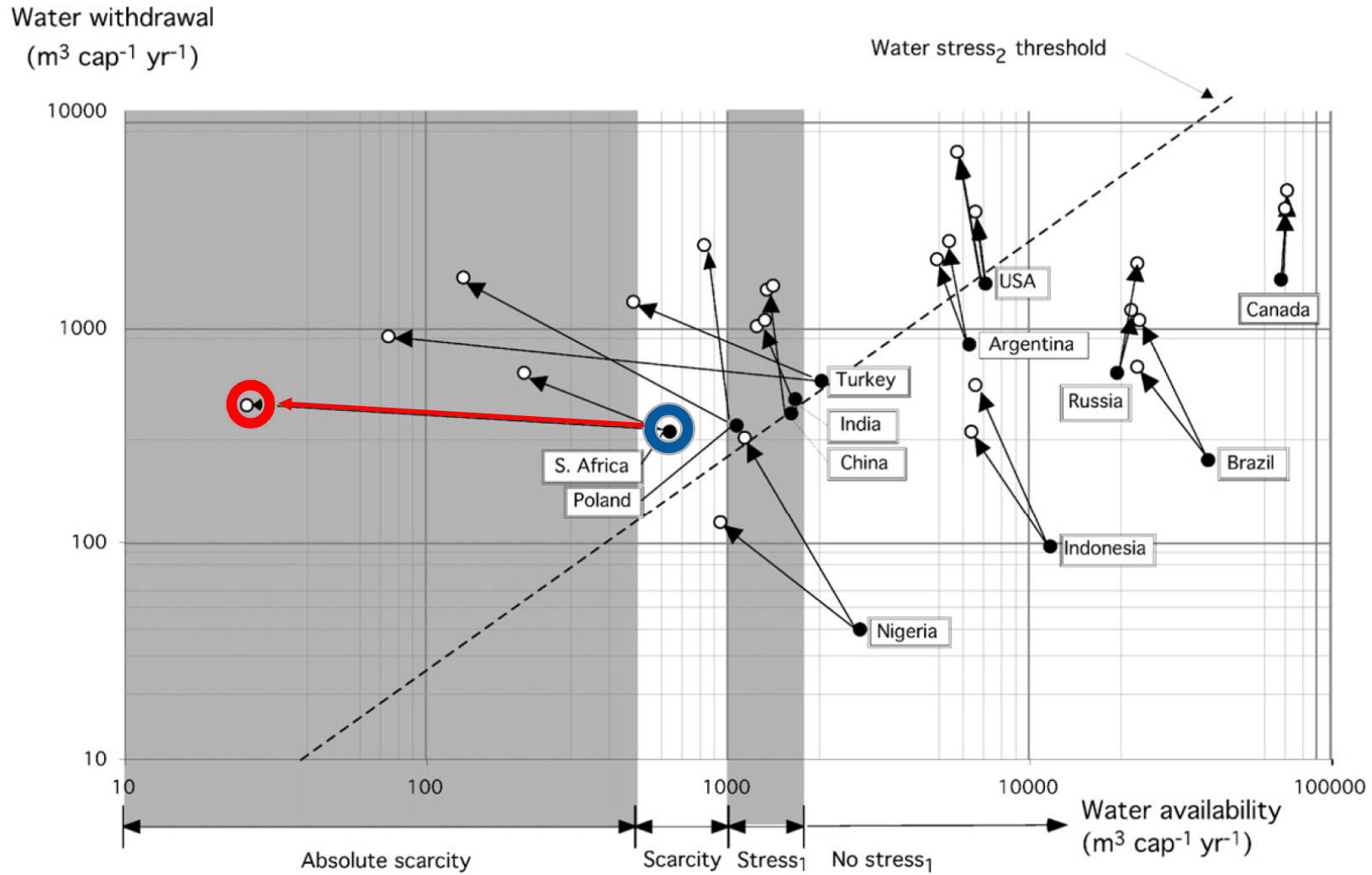


# *Jatropha curcas* – Water use

**Should we be concerned about  
biofuels and water use?**



## Regional water scarcity for 13 countries



Per-capita water withdrawal and availability. Filled dots = 1995.

The two arrows that originate from each dot point to the situation in the year 2075.

After Berndes (2002). *Global Environmental Change* 12, 253–271.

## First exploratory Research

- Aim: To develop predictive capability with respect to the impacts of large-scale planting of *Jatropha curcas* on water resources in South Africa.





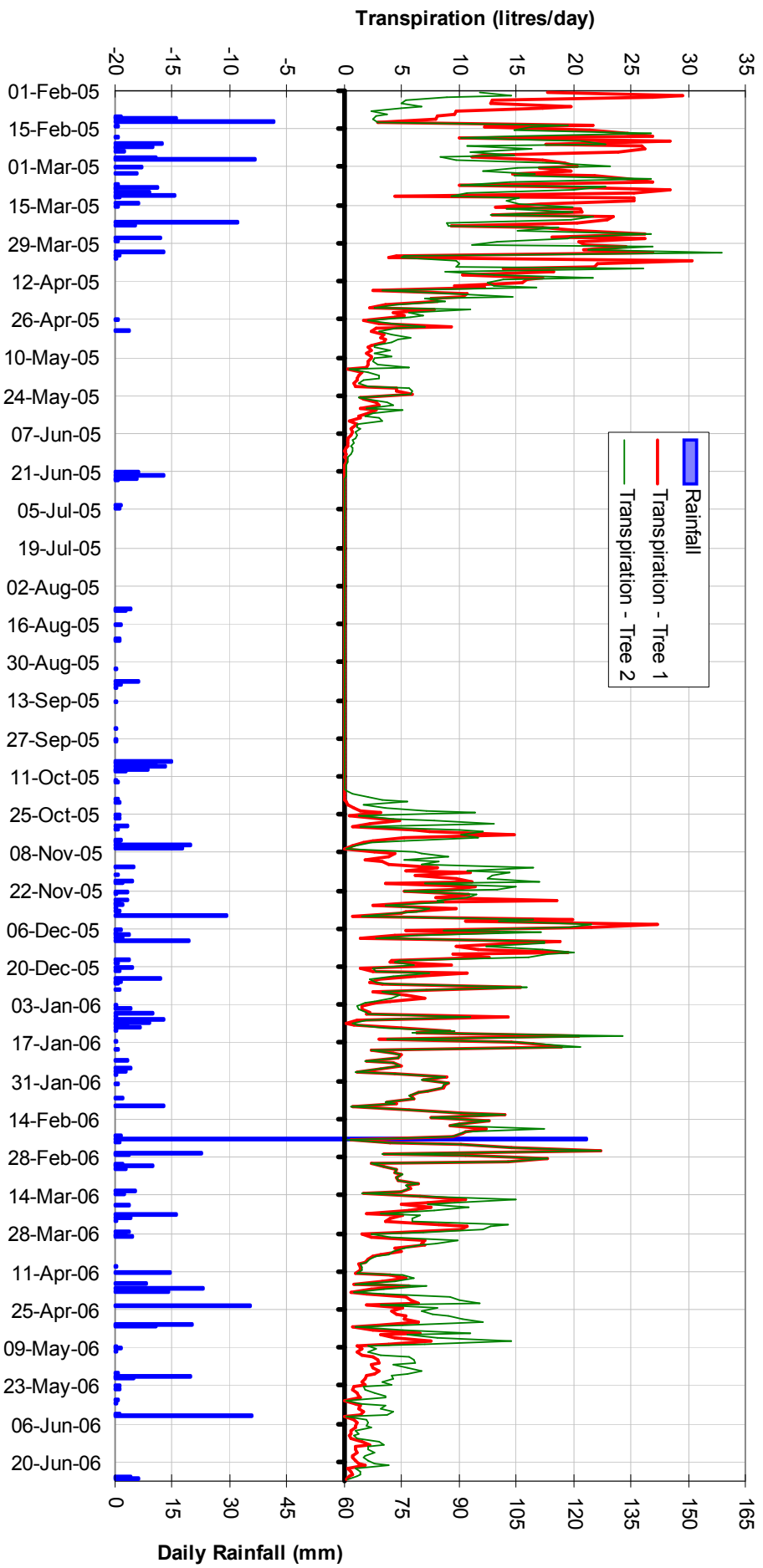
**Mature  
*Jatropha curcas***

**Site water balance:**

**Investigation into the impacts of large-scale planting of *Jatropha curcas* on water resources**

## Results (Zululand) – Daily Transpiration Data (litres)

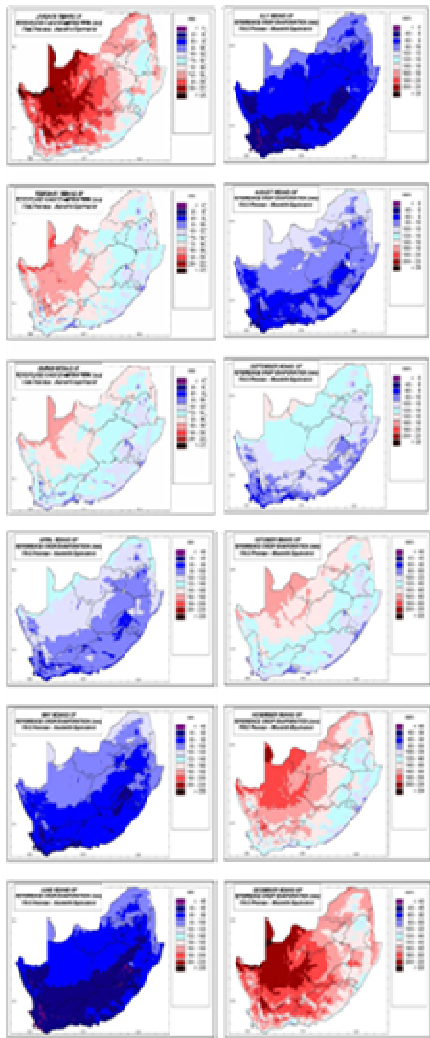
Daily Transpiration (litres) for 2 *Jatropha curcas* trees, with Rainfall (OSCA site)



- Max Trans = 33L.day<sup>-1</sup>, ave trans = 5.3L.day<sup>-1</sup>

# Regional Estimates

## Monthly P-M ET<sub>o</sub>

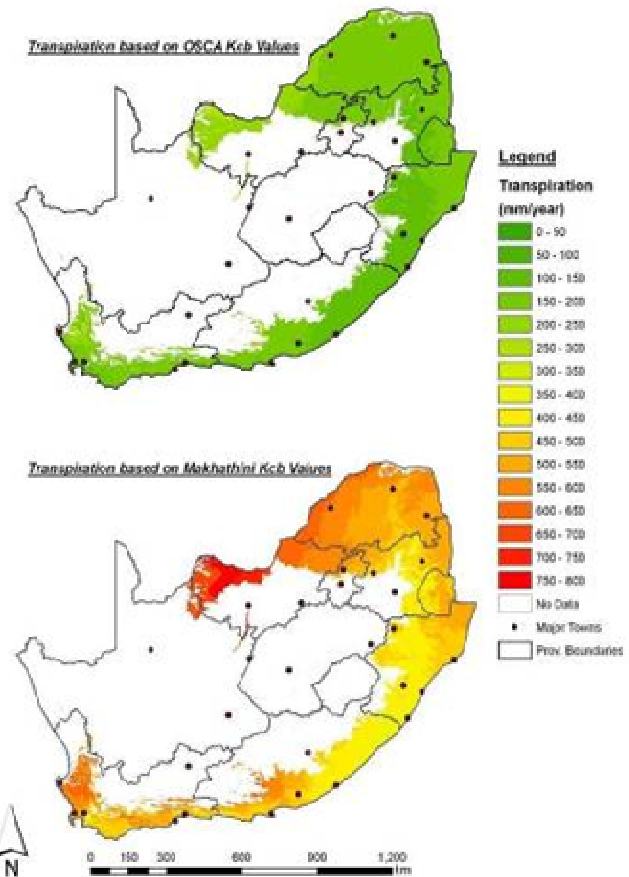


X

	K <sub>cb</sub>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
OSCA	0.18	0.18	0.26	0.21	0.14	0.06	0.00	0.00	0.00	0.00	0.04	0.14	0.15
Makh.	0.55	0.76	0.56	0.47	0.46	0.15	0.00	0.00	0.00	0.00	0.00	0.50	0.50

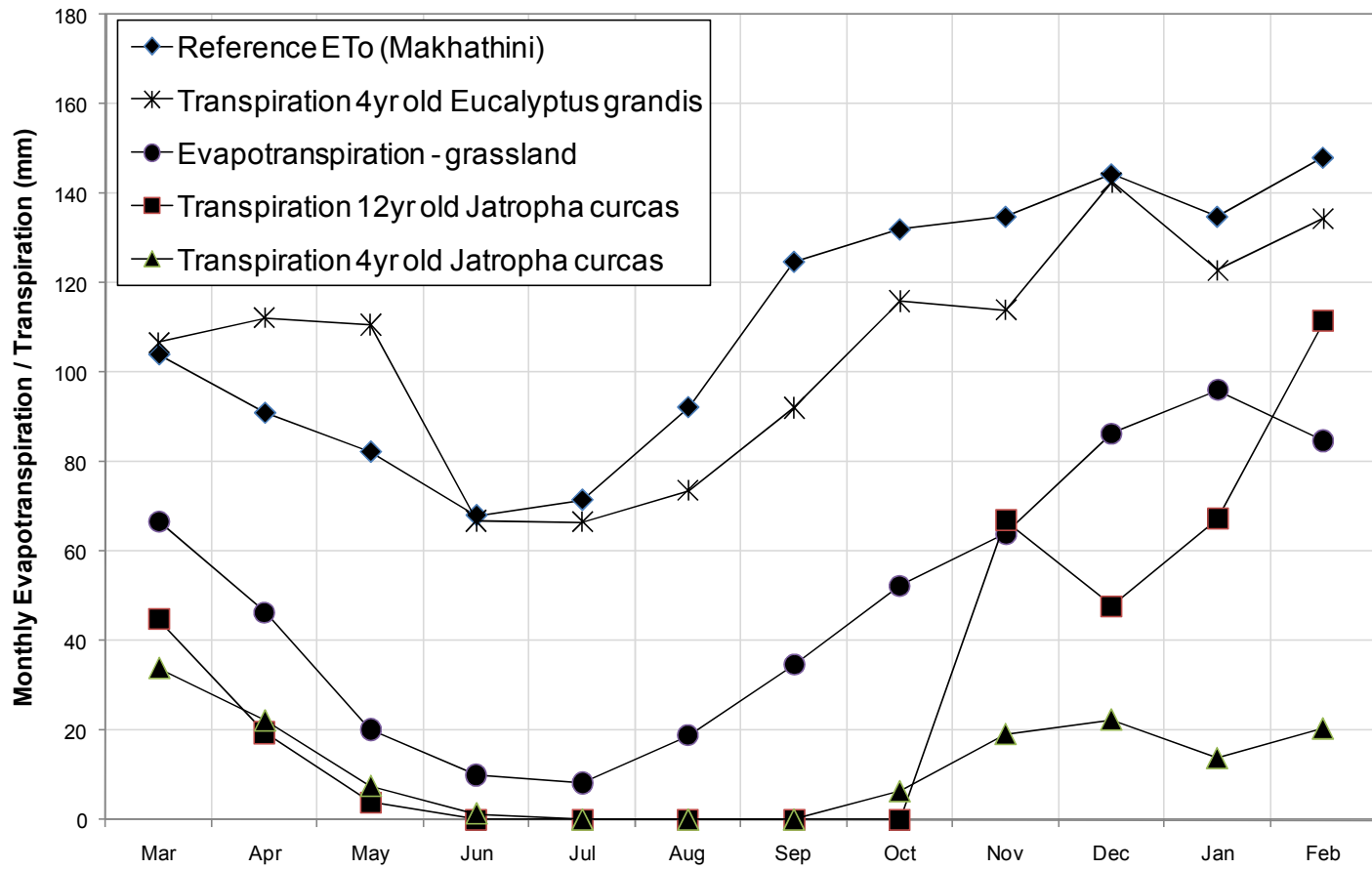
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## Jatropha curcas Transpiration in South Africa



Hallowes, J. 2007. Water use mapping of *Jatropha curcas*. In: Holl, M., Gush, M.B., Hallowes, J. and Versfeld, D.B. (Eds). 2007. *Jatropha curcas* in South Africa: an assessment of its water use and bio-physical potential. WRC Report 1497/1/07, Chapter 5.

**water-use of a range of measured vegetation types including *Jatropha curcas* (age 4 and 12 yrs), grassland and Eucalyptus plantations.**



**Compared to the other vegetation types, *Jatropha* water use was less than for natural vegetation and significantly below that used by a typical Eucalyptus plantation**

# Conclusion

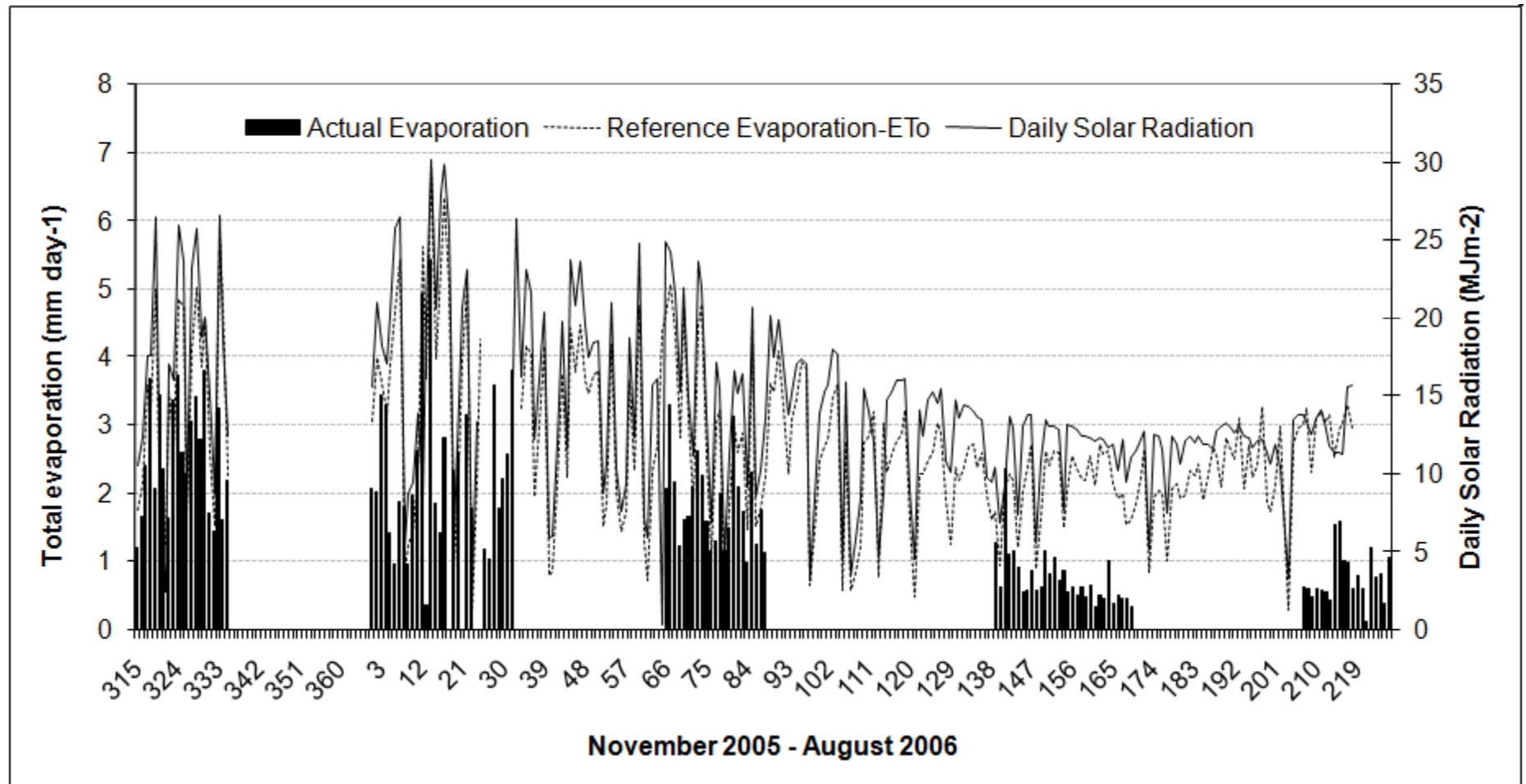
- In the areas where *Jatropha* can be planted it is unlikely to use more water than indigenous vegetation types.
- It was thus unlikely to have a streamflow reduction impact as defined by the SA National Water Act of 1998.

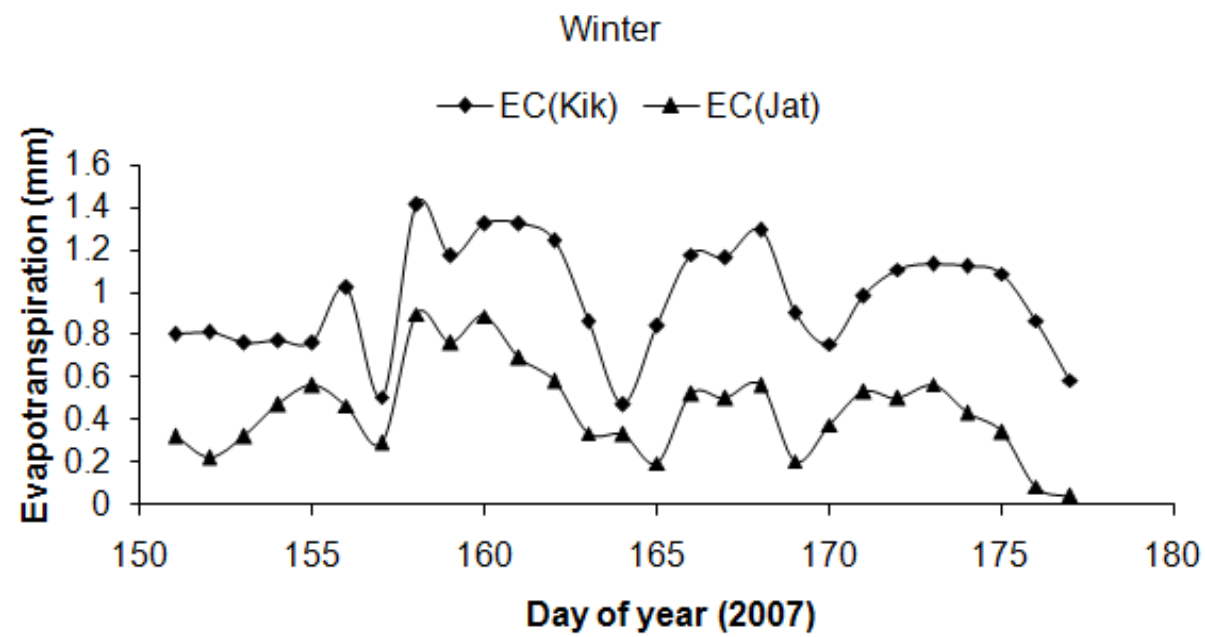
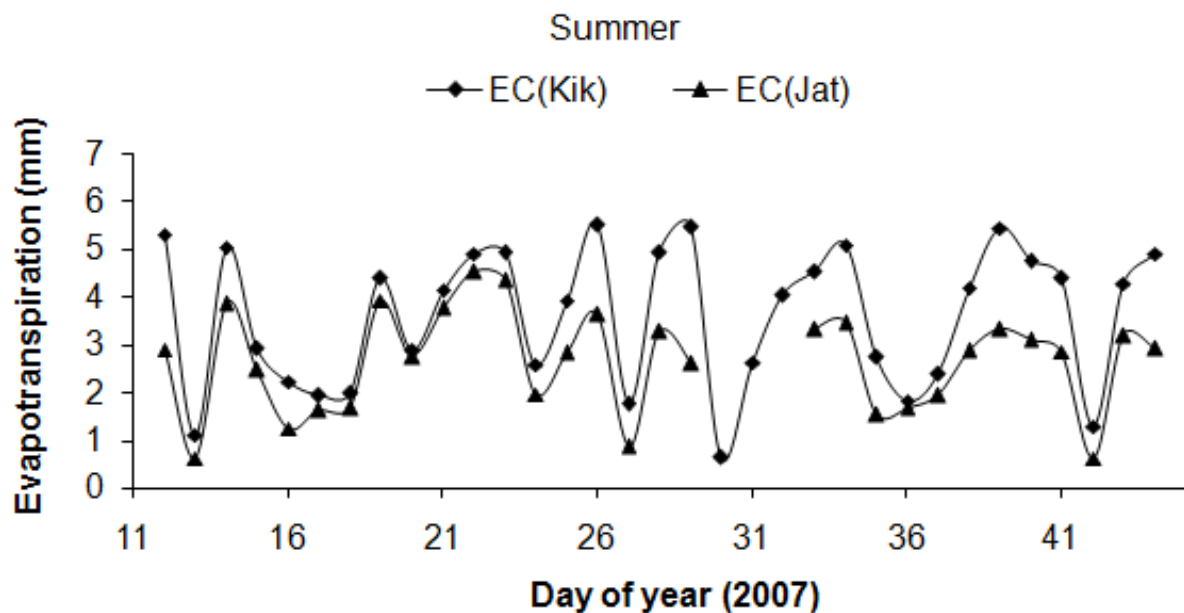
**Plot studies - *Jatropha* grown in a silvopastoral (Kikuyu) agro-forestry system**



**Total evaporation - Ukulinga Research Farm (UKZN) Pmb.**

## Total evaporation of *Jatropha curcas*

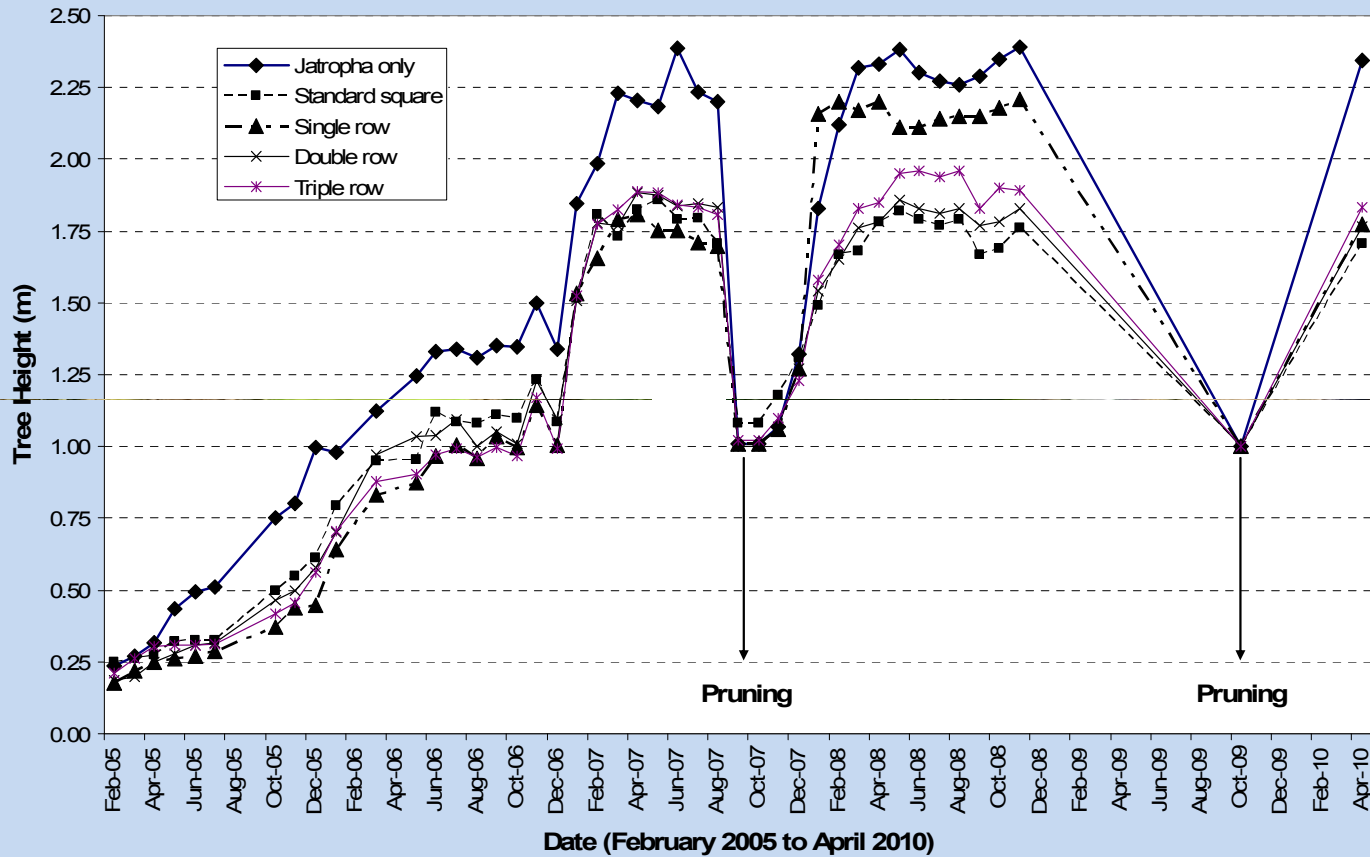




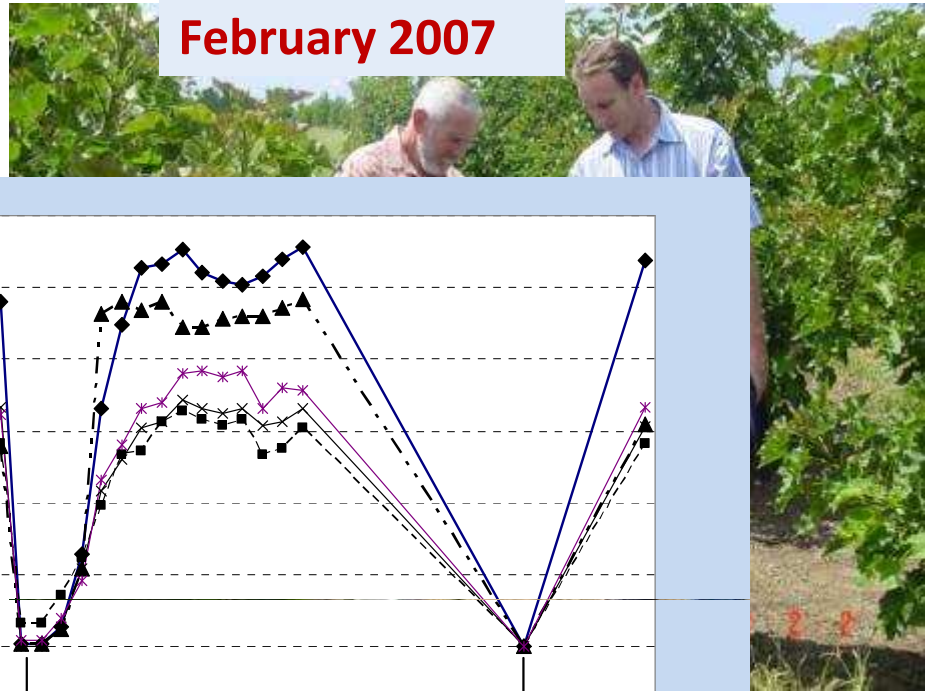
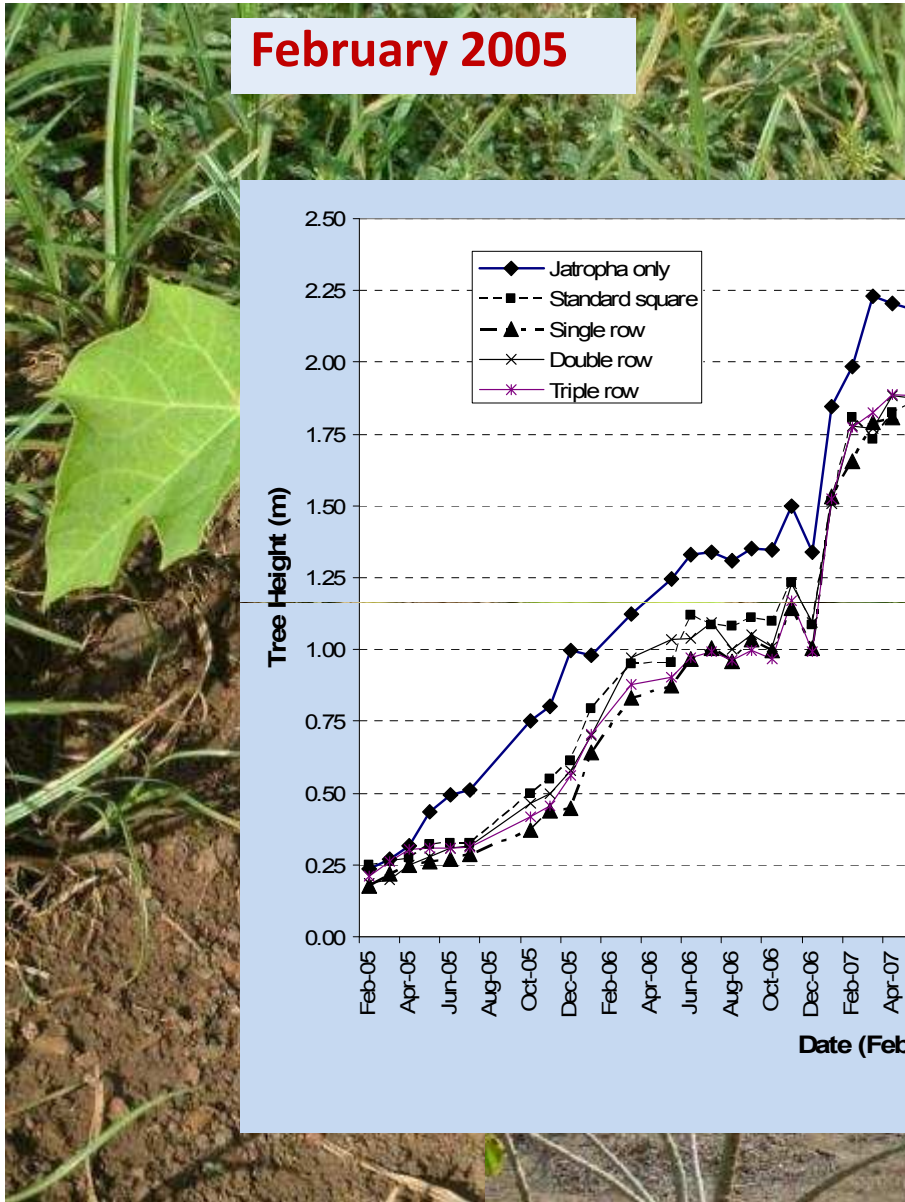
# Growth (tree height) of *Jatropha curcas*

February 2005

February 2007



09



# Pruning



2007



2008

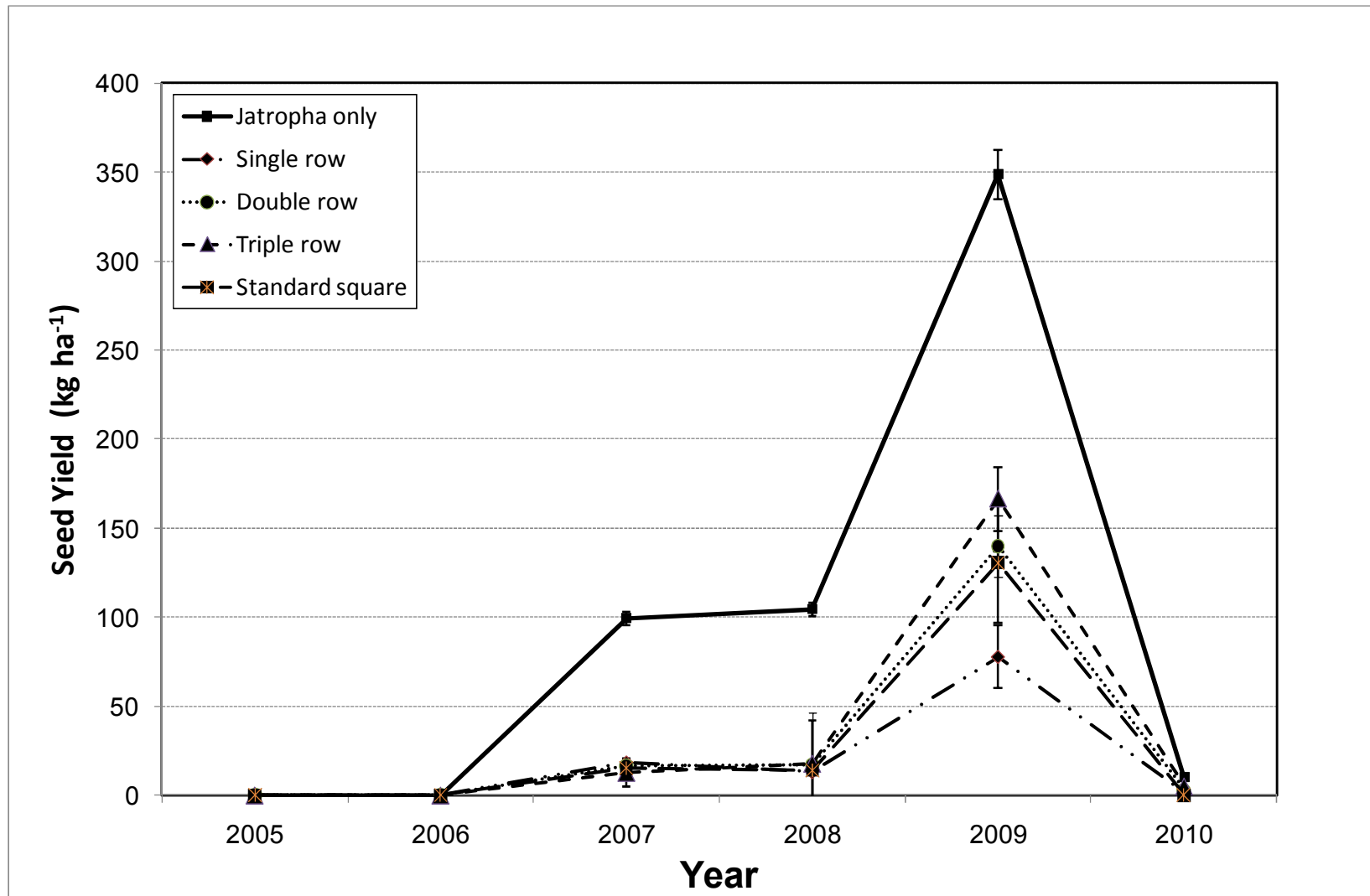
## Yield (*Jatropha curcas* as an energy crop)

- Harvested part is fruit containing 3 seeds.
- Seeds = 70% of mass (30% is fruit coat).
- Gross energy is 31- 46 MJ kg<sup>-1</sup>.



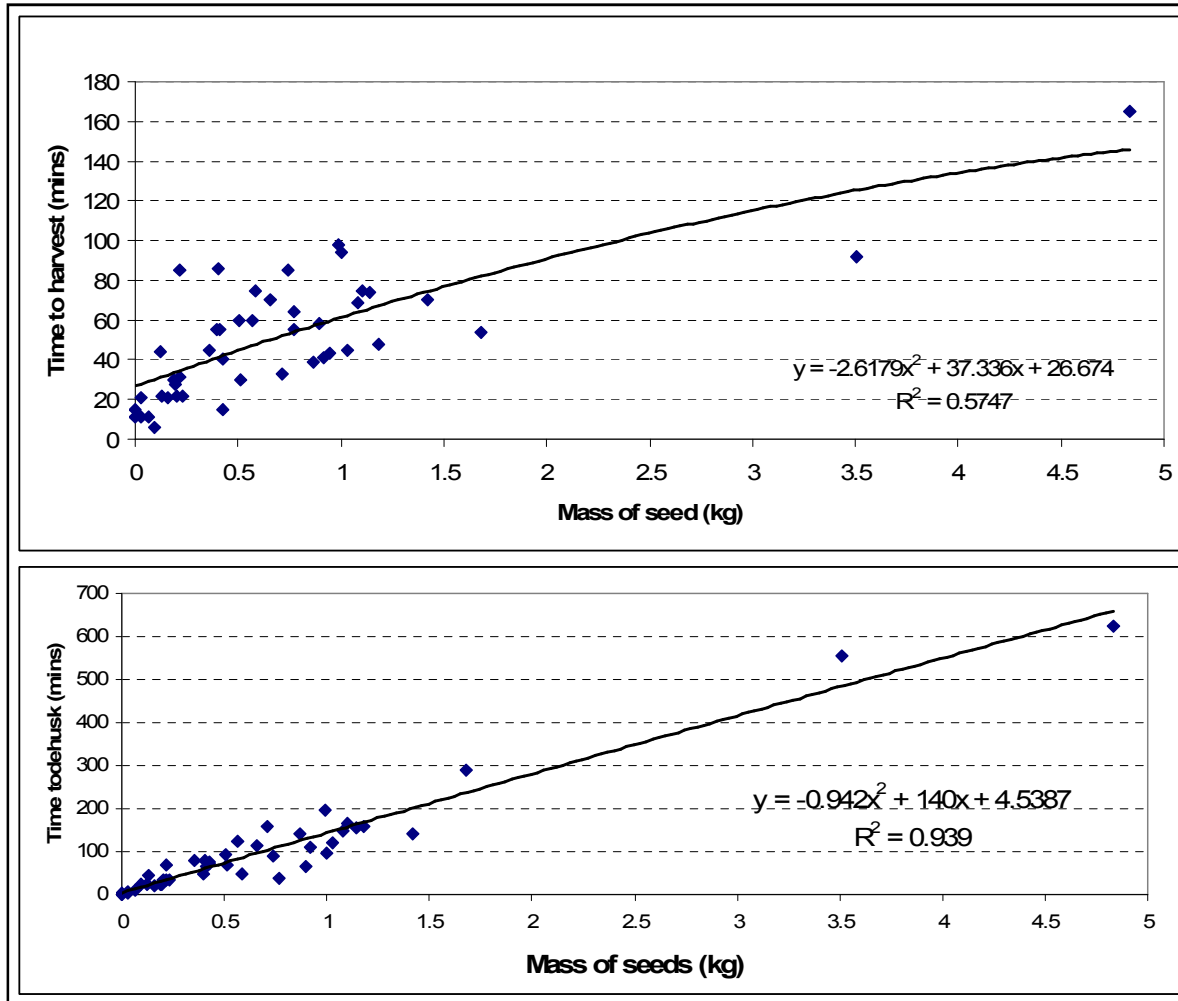
- Low production figures apply to 1-2 yr old plantations.
- Current reported yields 0.6 to 4.1 t seed ha<sup>-1</sup>.
- Max 7.8 t projected for mature stands.

# Seed Yield



# Low labour Cost?

Relationship between the mass of *Jatropha* seeds and the time to harvest and to dehusk



Conclusion:  
Harvesting will  
require large  
labour inputs

# Tolerance to pests and diseases

The assumed tolerance generally based on singular trees and does not apply to *Jatropha* grown in plantations.

In plantations serious problems have been reported with fungi, viruses and attack by insects. This has also been our experience at Ukulinga



Insect Damage



Fungal Damage



# Conclusions

1. Claims of low water use verified.
2. Claims of low labour input not true. Problems with mechanical harvesting due to sequential flowering.
3. Tolerance to pests and diseases not true in plantations. Therefore increasing input costs through a need for insecticides and fungicides.
4. No information on alien invasiveness.
5. High yields not observed

**The South African results are so unequivocal that *J. curcas* under the experimental conditions does not fulfil the claims that it is a “wonder” biodiesel plant.**