Biokenaf

Contract n°QLK5-CT2002-01729

2nd technical meeting
Athens, 23-24 October 2003

INRA CONTRIBUTION

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Samuel Quinton
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INRA main involvement

- ***WP2 : Adaptability and productivity field trials***
  - –Task 2.2 : Effect of different sowing dates and plant populations on biomass yields.
  - –Task 2.3 : Effect of irrigation and nitrogen fertilization on biomass yields.
- ***WP3 : Development of the crop growth simulation model***
  - –Task 3.1 : Development, calibration and validation of the crop production simulation model.
- ***WP6 : Environmental impact assessment and life cycle analysis of kenaf production and use***

Trials localisation

- **Lat.** 49°52’44’’ ; **Long.** 03°00’27’’
  Alt. 85m
- **oceanic temperate climate**
- **Temperature** Tm = 10.7°C
  Spring : 13°C; Summer : 17°C
  Autumn : 7.5°C; Winter : 5.5°C
- **Average rainfall** 703.5 mm/yr
  Spring : 147 mm; Summer : 184 mm
  Autumn : 243 mm; Winter : 133 mm
- **Average PET_0** 695.55 mm/yr
- **Soil type** organic clayey silt

Data already collected

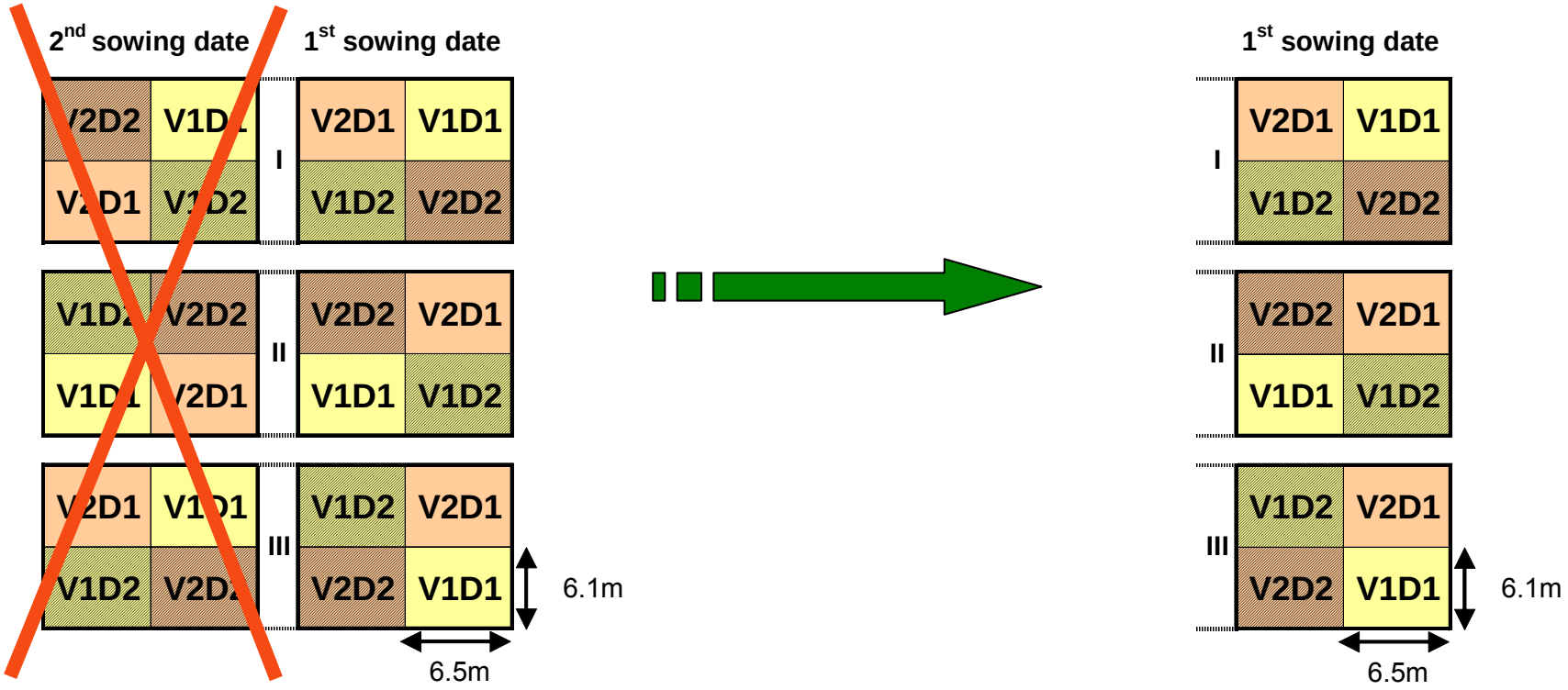
- **Meteorological data**
  - Temperature (min & max)
  - Global radiation
  - Precipitation
  - Air humidity
  - Wind speed
  - PET
- **Phenological data**
  - Date of emergence (50-100%)

- **Growth data (every 2 weeks)**
  - Plant height (5 plants per plot)
  - Stem diameter (5 plants per plot)
  - Number of leaves on primary axis
- **Productivity data (every 3 weeks)**
  - Fresh and dry matter (harvest row=2 m):
    - ✓On leaf blades, stems and leaf stalks
    - ✓Total
  - Leaf Area Meter

WP2 Task 2.2

Effect of different sowing dates and plant populations on biomass yields

Experimental design



Sowing dates

1st sowing date : 28/05/2003

2nd sowing date : 20/06/2003

Densities

D1 = 200 000 plants/ha

D2 = 400 000 plants/ha

Varieties

V1 = Everglades 41

V2 = Tainung 2

basic N Fertilization

N = 150 kg/ha

Crop management sequence

Previous crop
None

Harrowing (28/05)

Sowing (28/05)
Manual sowing machine

N fertilization (28/05)
150 kg/ha

Weed control (28/05)
alachlor : 2.4 kg a.i/ha

Pest management

Myzus persicae

1) Lambda-Cyhalothrine (27/06)

↳6.5 g a.i/ha

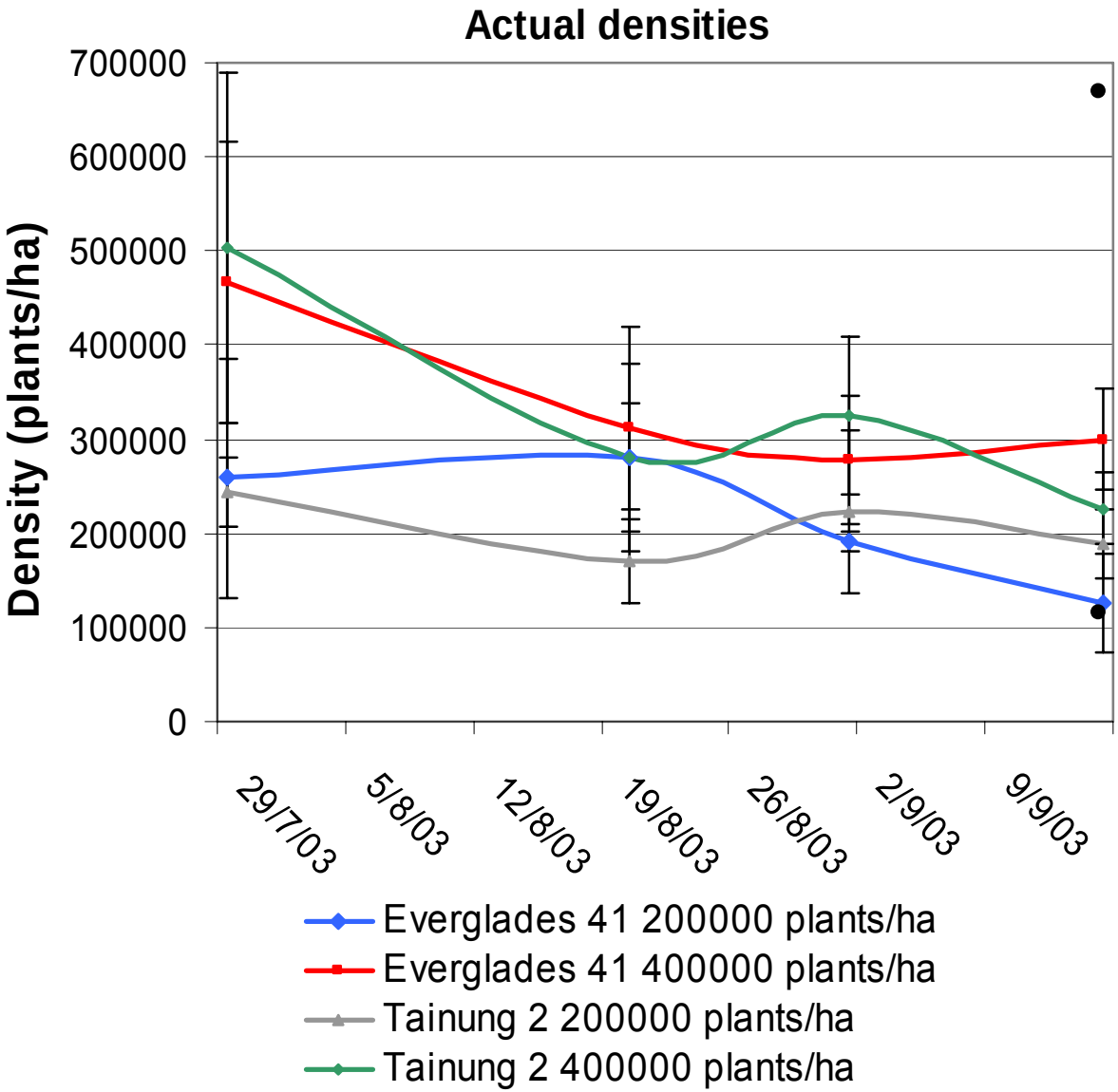
2) Lambda-Cyhalothrine (04/07)

↳7.5 g a.i/h

3) Lambda-Cyhalothrine + Pyrimicarbe (15/07)

↳7.5 g a.i /ha + ↳150 g a.i/ha

Actual densities



Sowing densities higher than those planned

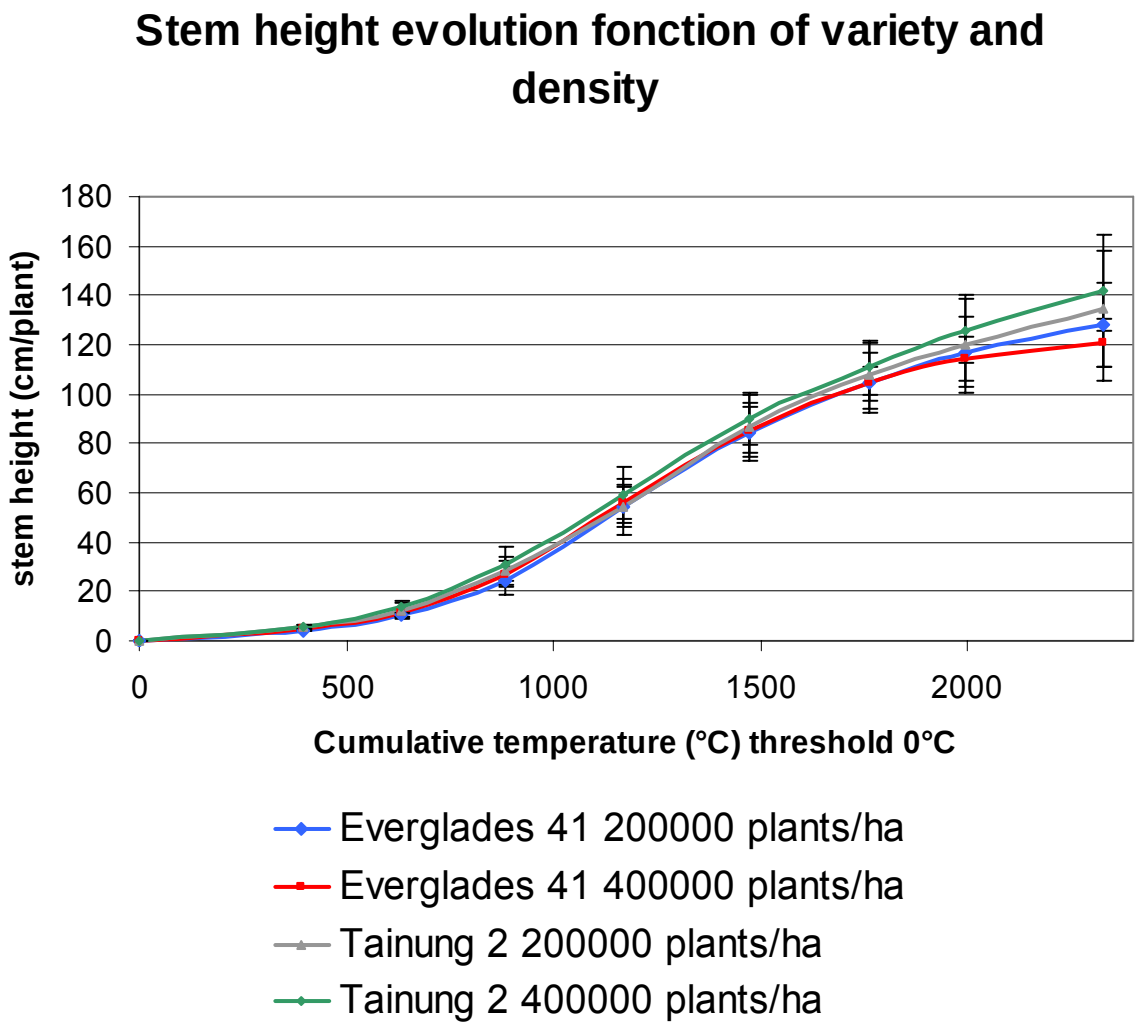
- Strong standard deviation
- Proportion respected anyway

Self thinning for higher densities

- Equilibrium (between 155000 plants/ha and 260000 plants/ha)

Results / discussion

Stem height

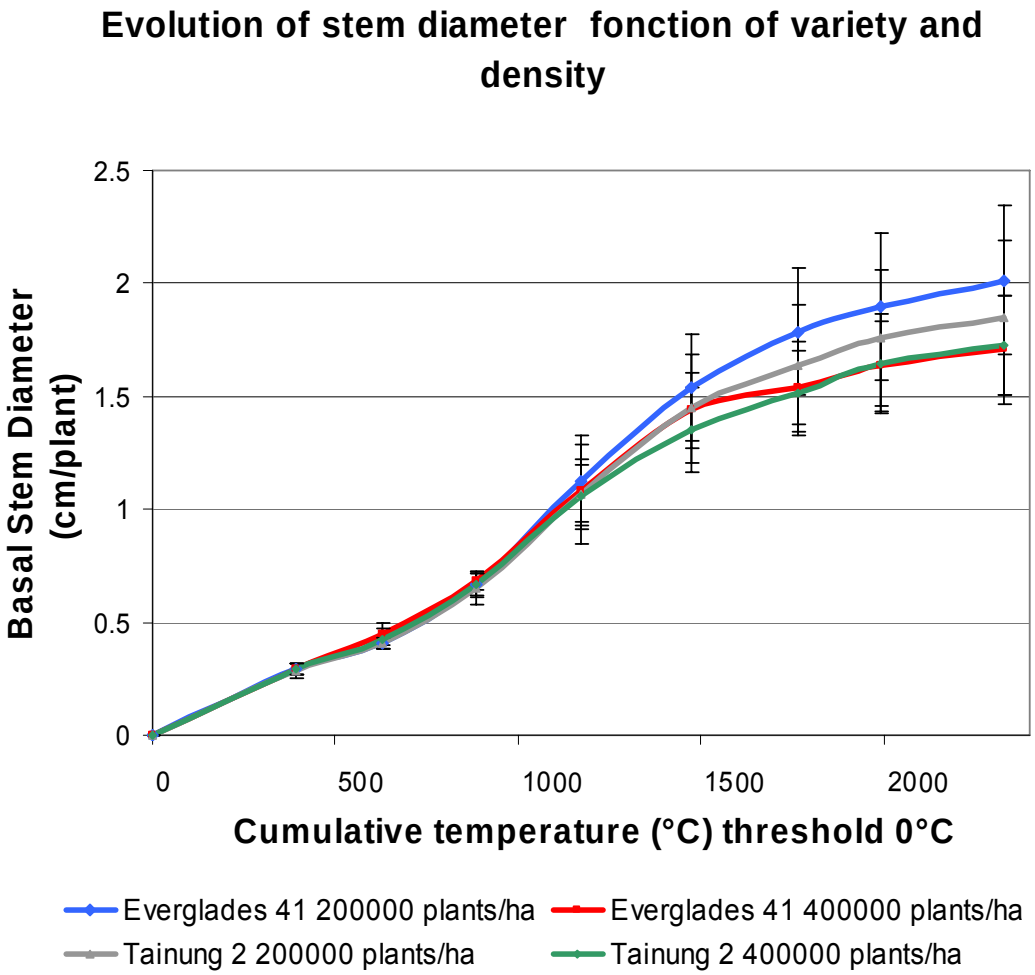


- Hypothesis :
  - Temperature threshold of growth = 0°C

    (No reference found)
- Variety effect :
  - Tainung 2 > Everglades 41
- Density effect :
  - Not obvious
- Stem heights in September :
  - Everglades 41 : 127 cm
  - Tainung 2 : 140 cm

Results / discussion

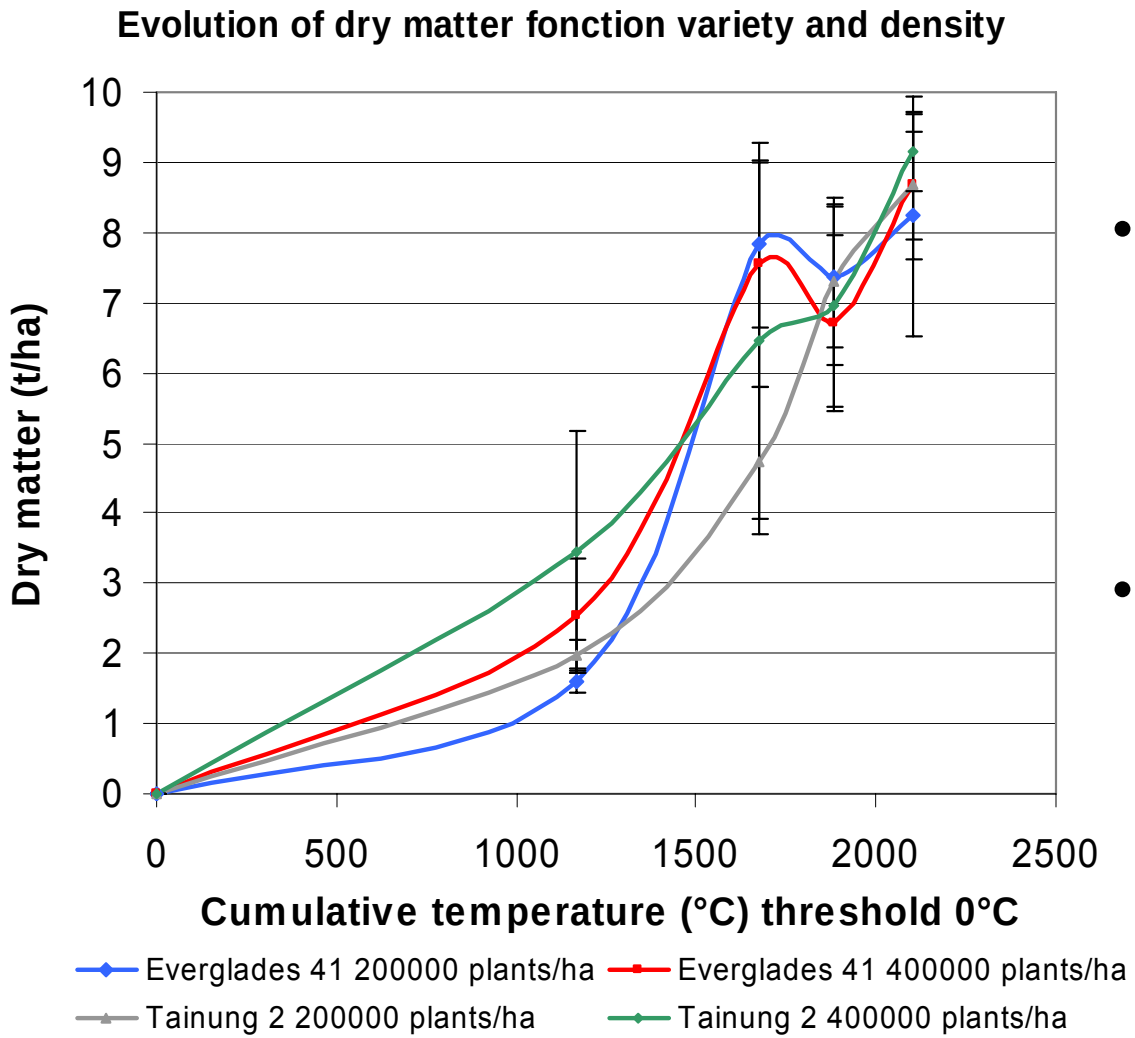
Stem diameter



- Density effect :
  - ↳ Stem diameter thicker at lowest density
- Variety effect :
  - ↳ Not obvious
- Diameter in September :
  - ↳ 17-20 mm

Results / discussion

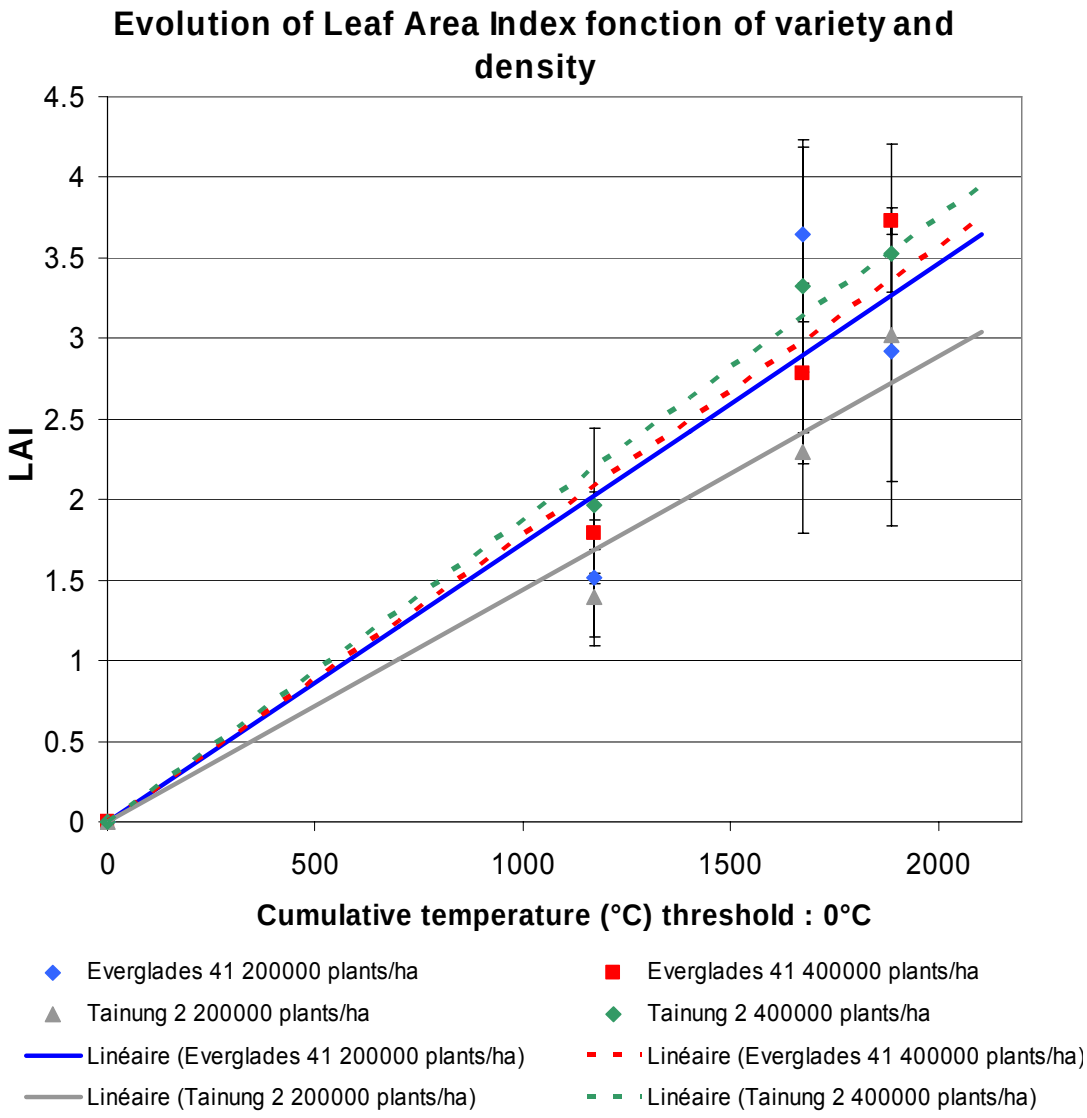
Dry matter yield



- Density and variety effects
  - ↳ Not obvious
- Best dry matter yields in September
  - ↳ 8-9 t/ha

Results / discussion

Leaf Area Index



- Strong standard deviation
- Slight effect of density (?)
- No variety effect

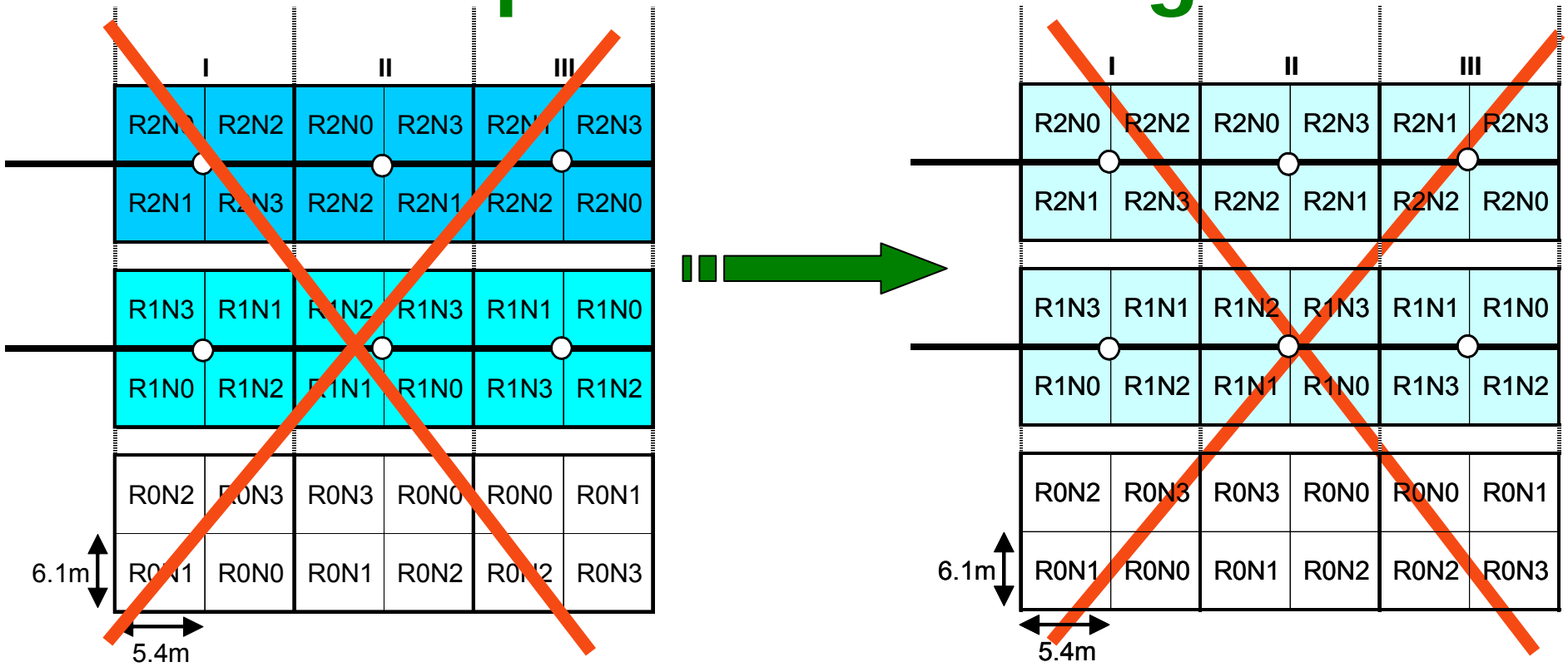
Task 2.2
Conclusion

- Effects of density :
  - ↳Higher stem diameter at lower density
  - ↳Kenaf is thinning itself at higher density
    - ⇨New densities could be tested in North France : 100000 plants/ha and 200000 plants/ha
- Effects of variety
  - ↳No major difference between varieties except the height (Tainung 2 > Everglades 41)

WP2 Task 2.3

Effect of irrigation and nitrogen fertilization on biomass yields

Experimental design



Variety Gregg

Density 200 000 plants/ha

Irrigation

R0 = no irrigation

R1 = 60% of PET

R2 = 100% of PET

N Fertilization

N0 = no fertilization

N1 = 50 kg N/ha

N2 = 100 kg N/ha

N3 = 150 kg N/ha

Total Irrigation

40mm

Crop management sequence

Previous crop
None

Harrowing (28/05)

Sowing (28/05)
Pneumatic sowing machine

N fertilization (28/05)

Weed control (28/05)
alachlor : 2.4 kg a.i/ha

Pest management

Myzus persicae

1) Lambda-Cyhalothrine (27/06)
   ↳ 6.5g a.i/ha
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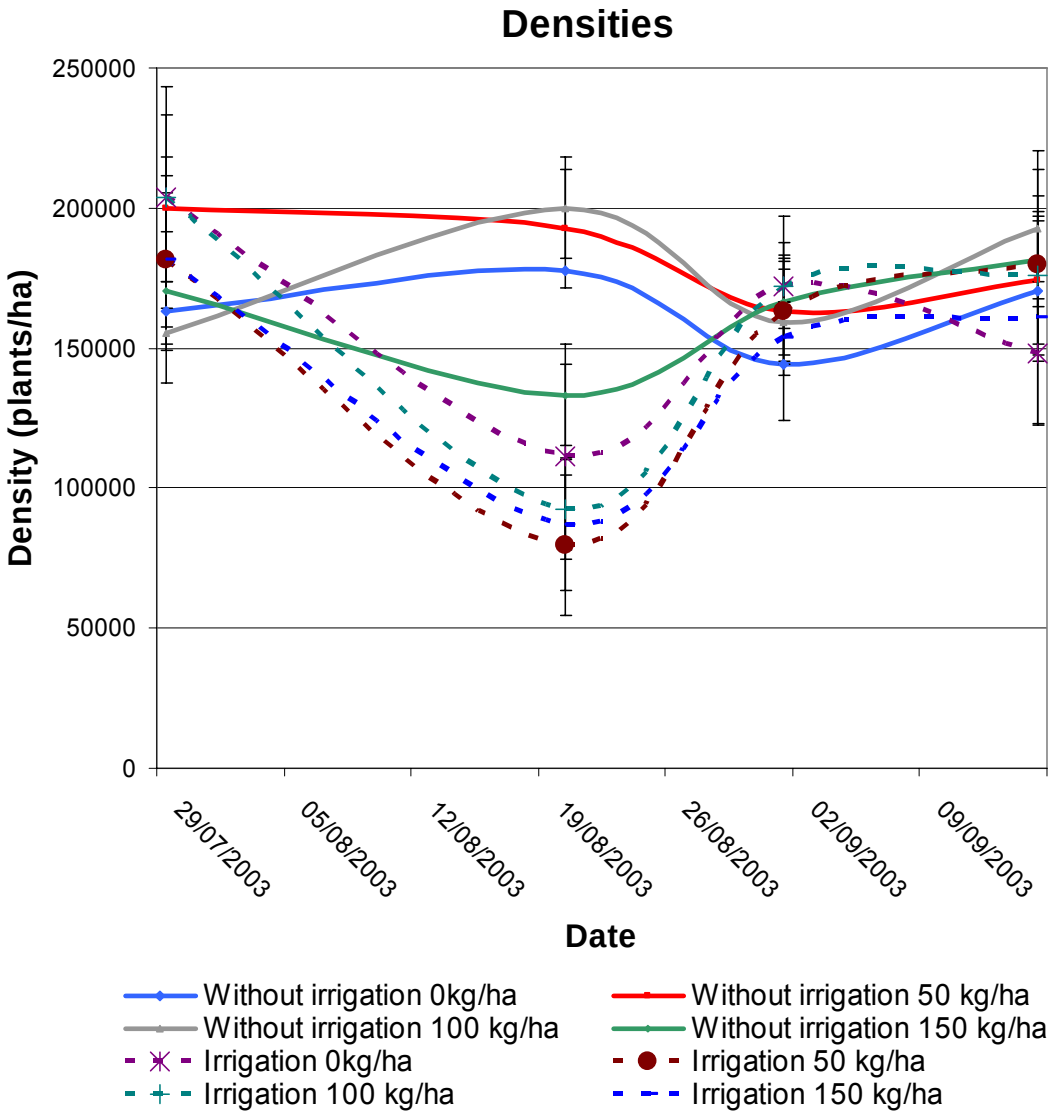
3) Lambda-Cyhalothrine + Pyrimicarbe (15/07)
   ↳7.5g a.i /ha + ↳150g a.i/ha

Irrigation (12-13/08)
Sprinklers : 40 mm

Results / discussion

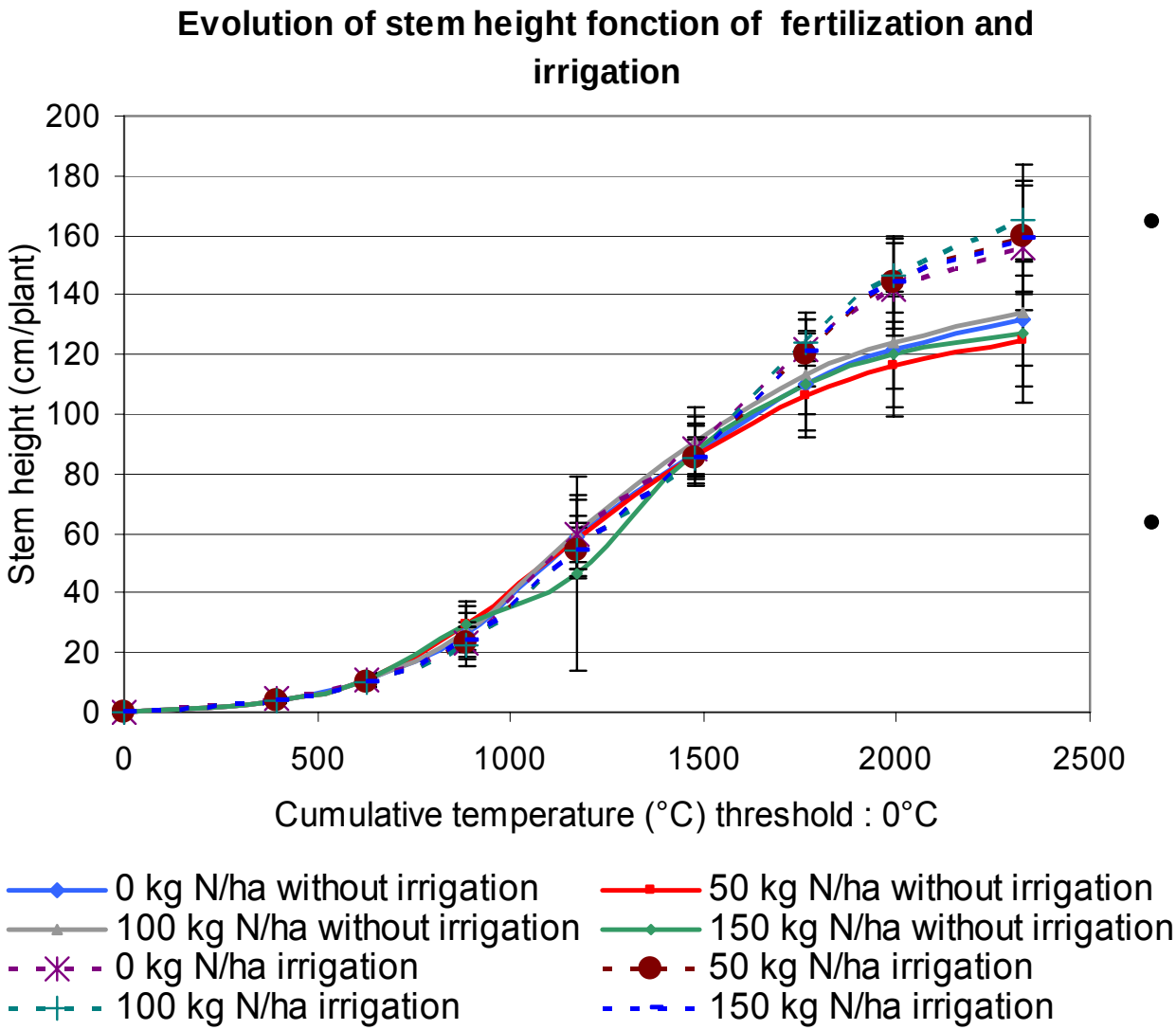
Actual densities



- Constant density during the growing period

Results / discussion

Stem height

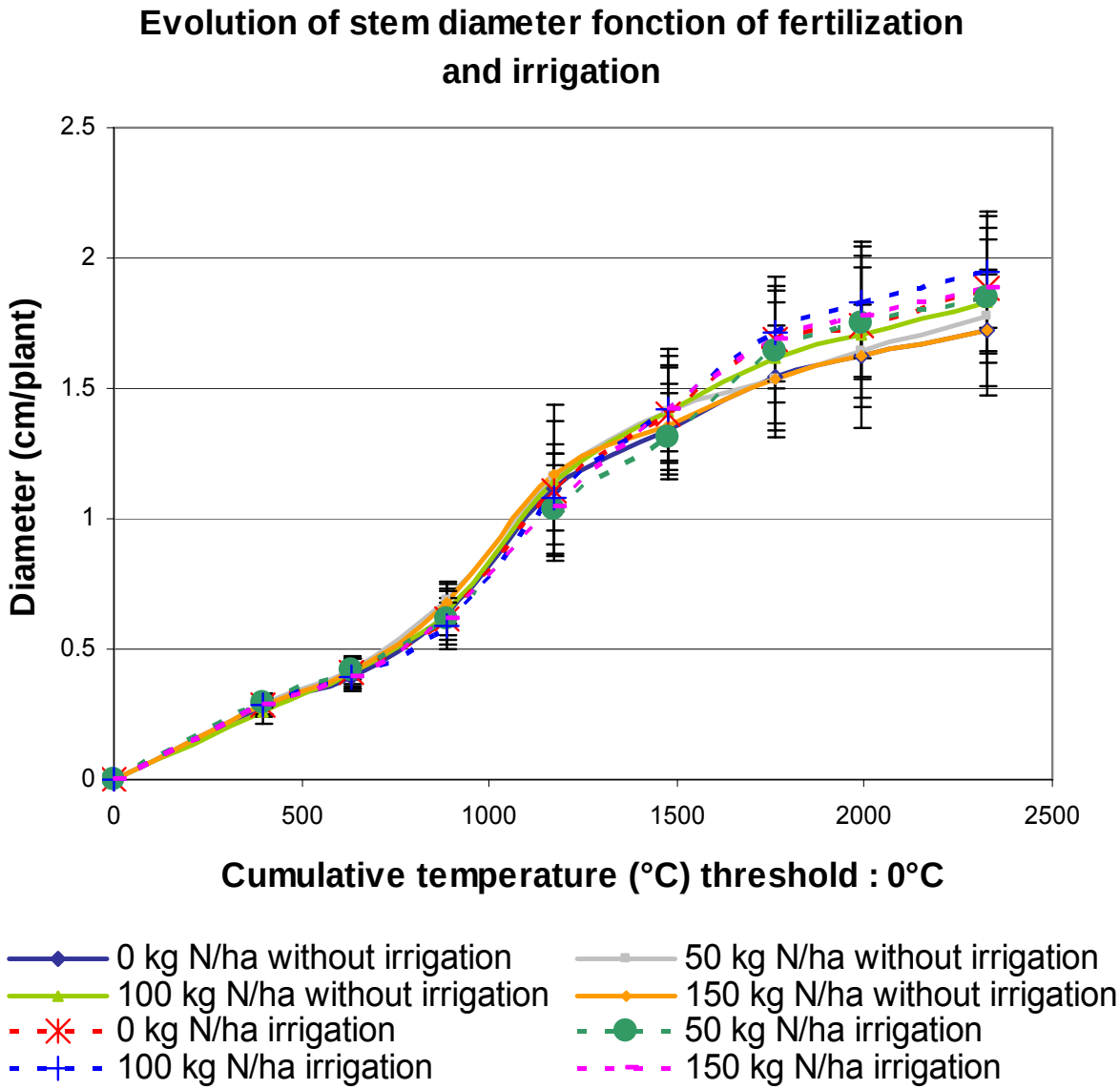


- N fertilization effect :
  - ↳ No effect observed

  (Initial N soil residue: 28.5 kg/ha)
- Irrigation effect :
  - ↳ Plants higher with irrigation

Results / discussion

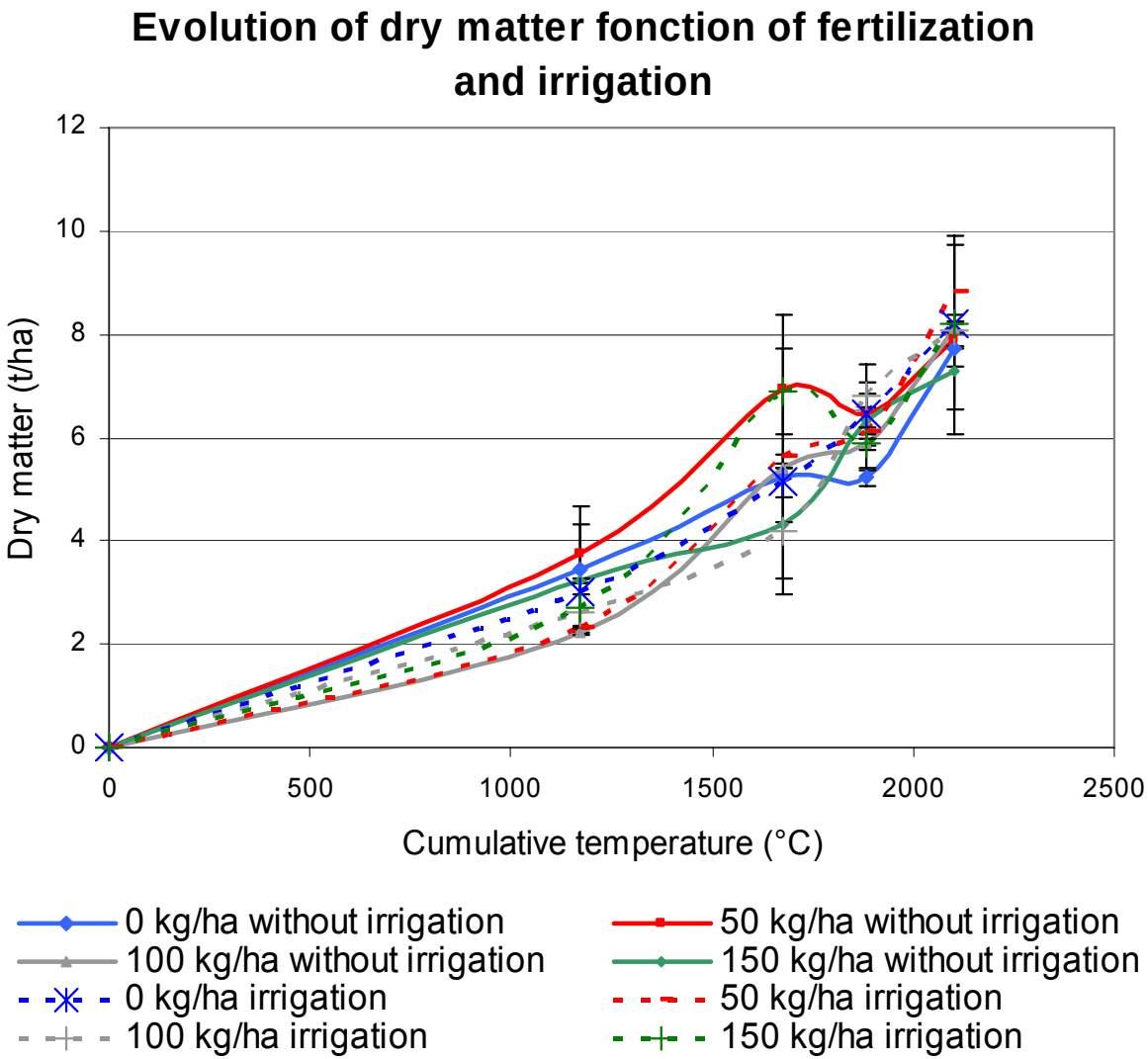
Stem diameter



- Slight effect of irrigation
- No effect of fertilization

Results / discussion

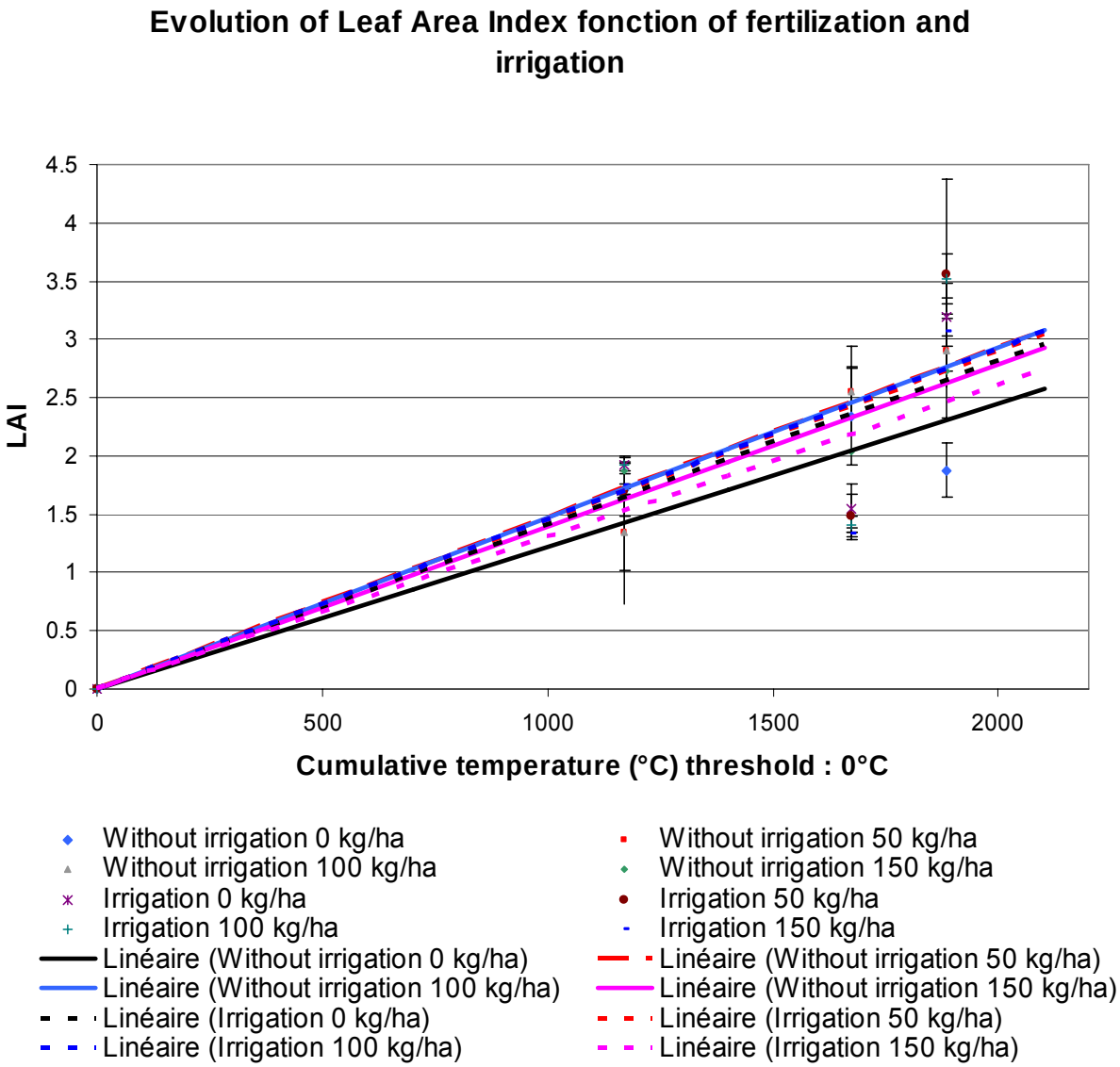
Dry matter yield



- No N-fertilization effect
- No irrigation effect

Results / discussion

Leaf Area Index



- No obvious effect of irrigation or N- fertilization

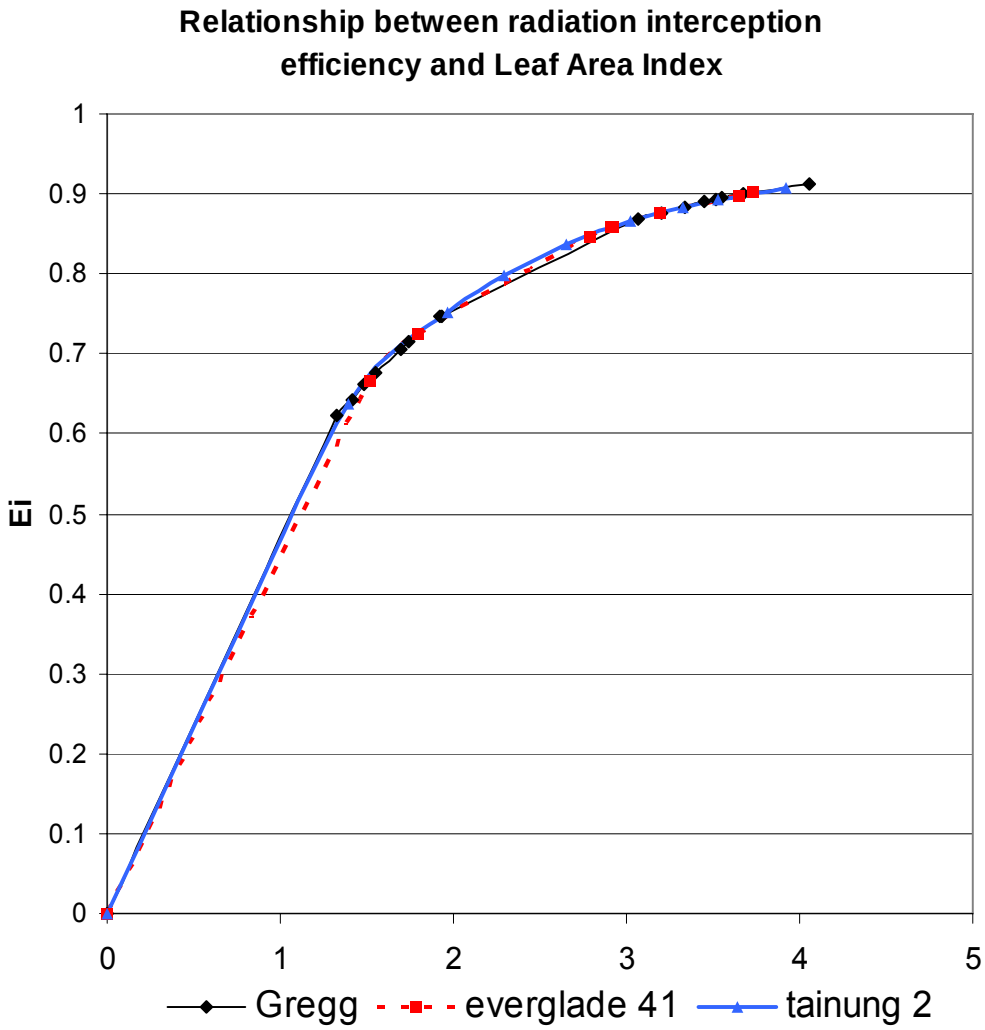
Task 2.3
Conclusion

- N fertilization effect
  - ↳No particular effects of N-fertilization at the tested levels
    - ⇨ 3 new levels (0, 150 and 300kg/ha) to test in north of France
- Irrigation effect
  - ↳Obvious effect of irrigation on stem height but not on dry matter yield

⇨Potential Yield in North of France in 2003 without irrigation or N-fertilization : 8 t/ha

Modelling

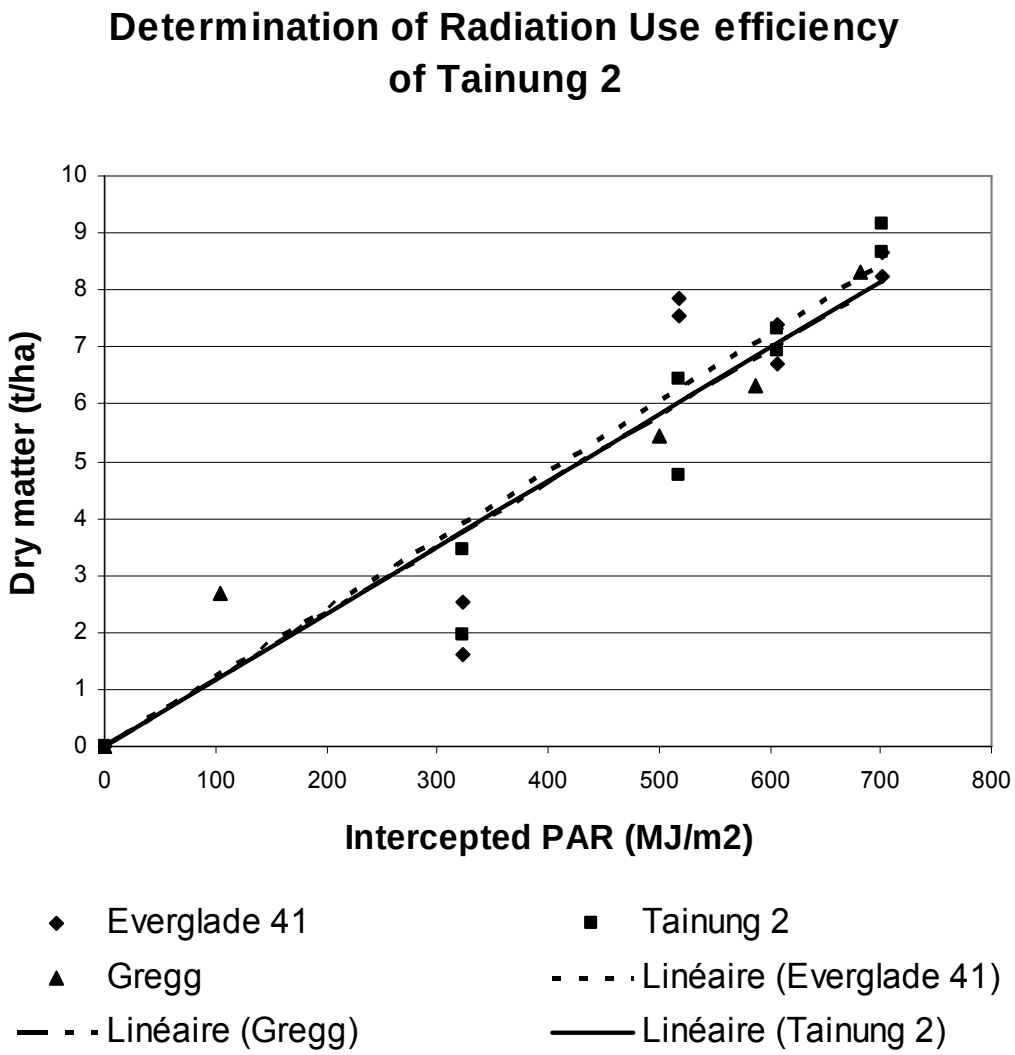
Determination of Radiation Interception Efficiency



- $\varepsilon i = 0.95 \times (1 - \exp(-k \times LAI))$
- Hypothesis k=0.8 for kenaf
  - Zea Mays :
    - k=0.5
  - Helianthus annum
    - k=1

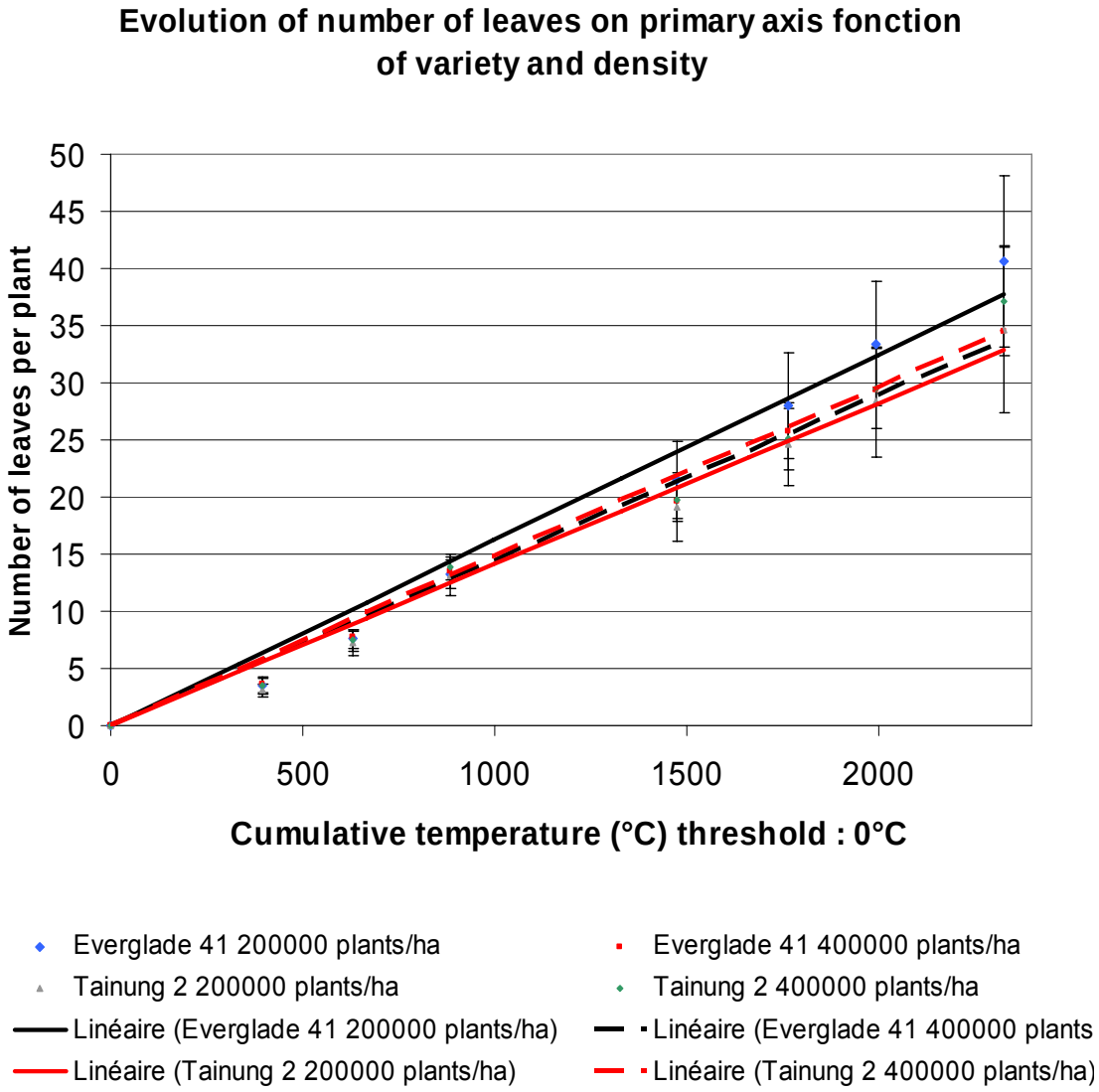
Modelling

Determination of Radiation Use Efficiency



- Slight difference between varieties
  - Everglades 41:1.21 g/MJ
  - Tainung 2 : 1.16 g/MJ
  - Gregg : 1.16 g/MJ
- Low value compared to other C3 species
  - *Triticum spp.* : 2 g/MJ
  - *Festuca spp.* : 1.89 g/MJ

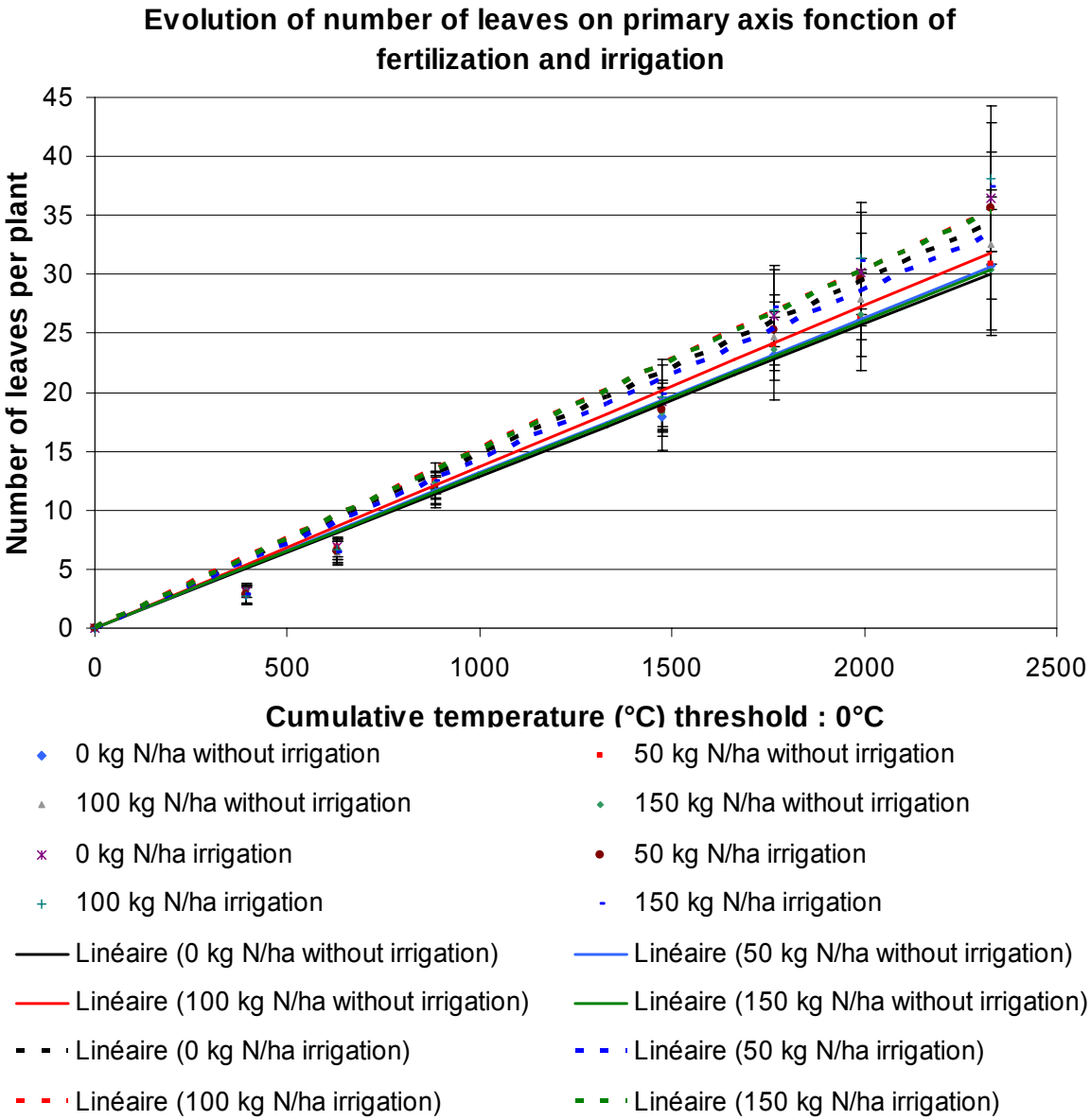
Modelling
Determination of Phyllochron (task 2.2)



- Phyllochron
  - Everglades 41 : 0.015 leaf/°C ($\pm 8.5\times10^{-4}$)
  - Tainung 2 : 0.014 leaf/°C ($\pm 3.5*10^{-4}$)
- Effect of density : not obvious
- Slight difference between varieties

Modelling

Determination of phyllochron (task 2.3)



- Effect of irrigation on phyllochron
  - with irrigation : 0.015 leaf/°C ($\pm 3.5*10^{-4}$)
  - without irrigation : 0.013 leaf/°C ($\pm 3*10^{-4}$)
- No effect of fertilization

Work to do in WP 2

- **Until the end of 2003**
  - Dates of flowering (50% and 100%)
  - Harvest : October and December
  - Analysis N,P,K of plants
    - for stems, leaves and leaf stalks
  - Statistical Analysis of our data
- **In 2004**
  - Densities, varieties and sowing dates in Estrées-Mons (North France)
  - N fertilization and irrigation trials in Toulouse (South France)

Questions

- Differences expected between Tainung 2 and Everglades 41 ?
- Effect of N-fertilization expected ?
- Densities : how to increase homogeneity in trials ?
- Natural enemies of kenaf ?
- Value of Temperature threshold of growth ?
- Value of K ?

Kenaf flower

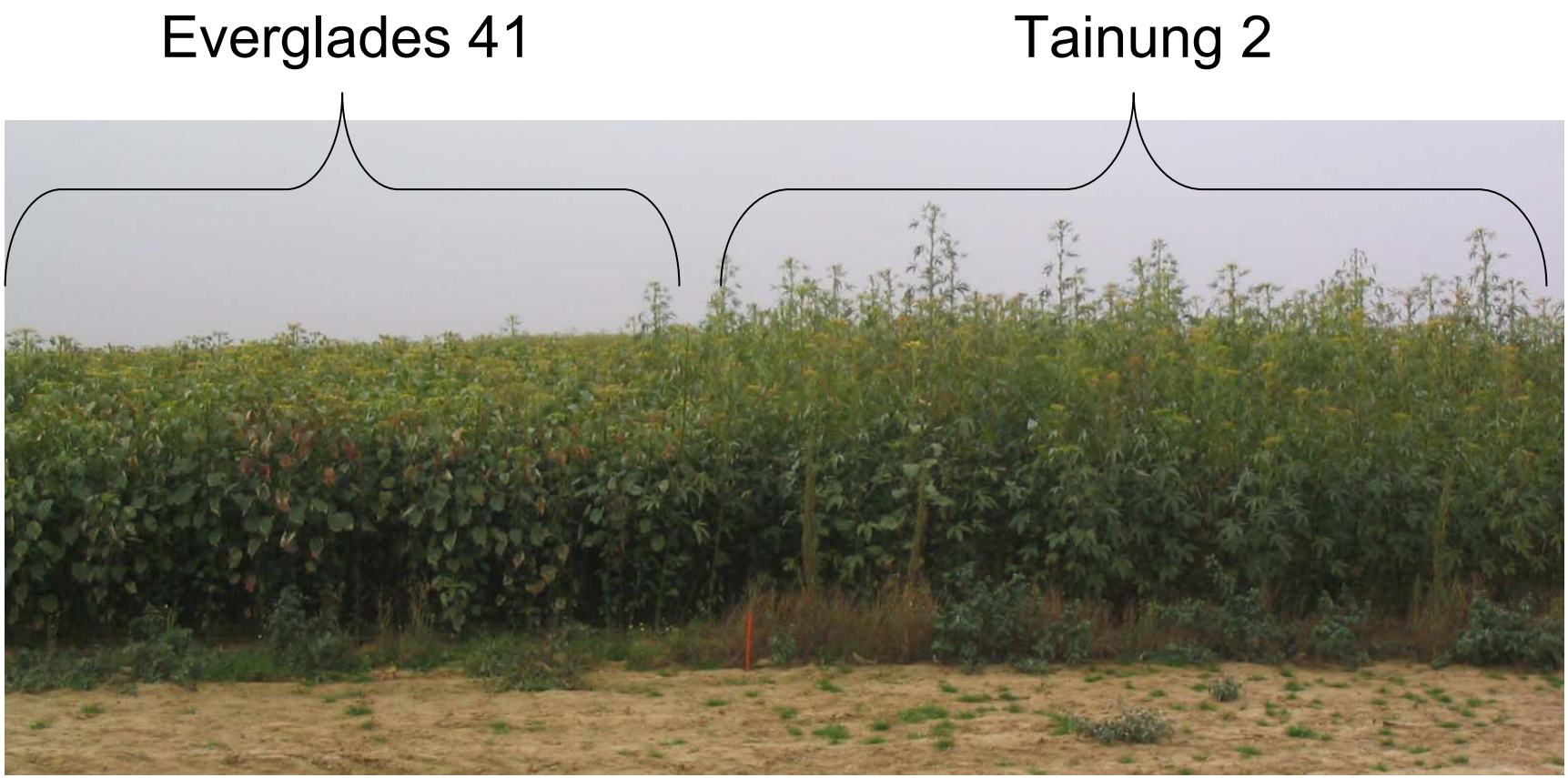
•Losses of plantlets on the 2nd sowing date trial (unknown causes).

- Heterogeneity of sowing density
- Sowing date : 28/05/03
- Date of emergence :
  - 50% : 02/06/03
  - 100% : 09/06/03

Manual sowing machine

Pneumatic sowing machine

Difference in stem heights between varieties



Morphological difference between leaf blades