BIOKENAF – QLK5-CT2002-01729

4th technical meeting

LISBON, 23-24 September 2004

Supervisor : G. Gosse

M.P. Boutin, S. Quinton

INRA

Institut national de la recherche agronomique

INRA main involvement

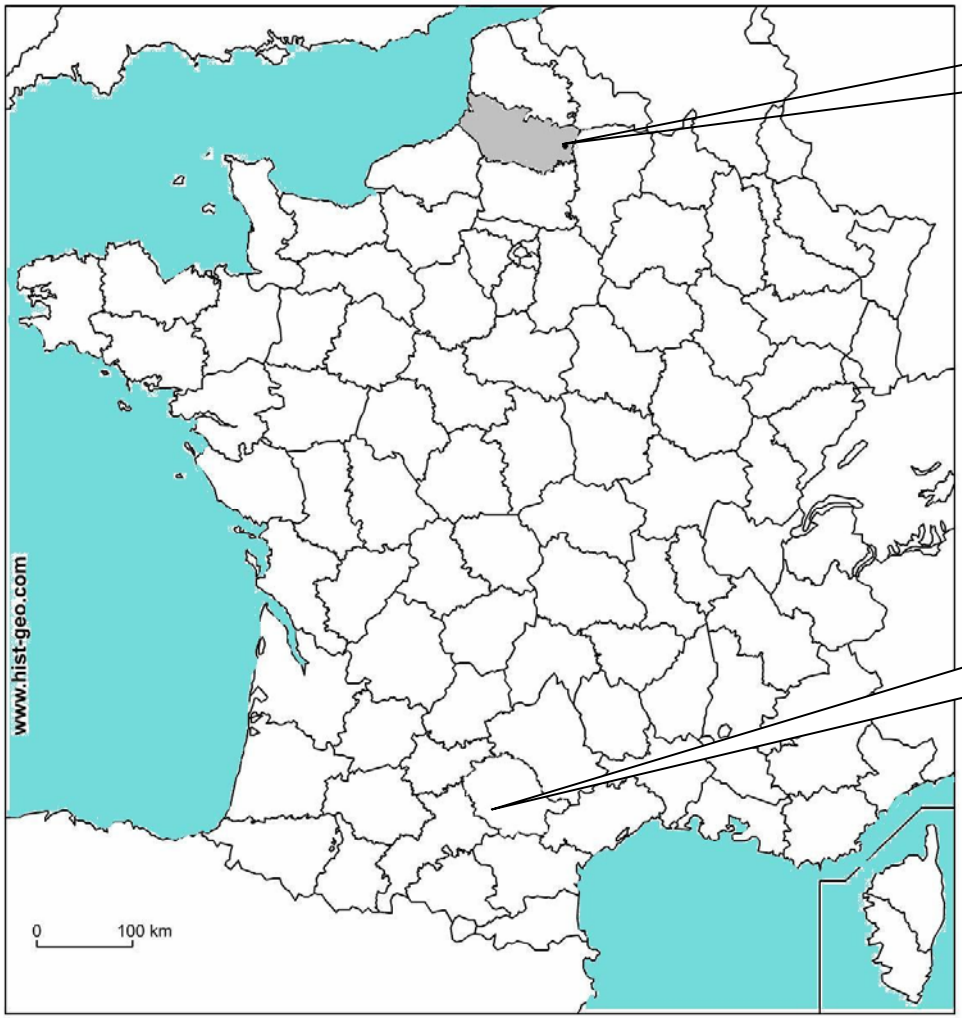
- ***WP2 : Adaptability and productivity field trials***
  - Task 2.2 : Effect of different sowing dates and plant populations on biomass yields.
  - Task 2.3 : Effect of irrigation and nitrogen fertilization on biomass yields.

- ***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***

WP2 : Adaptability and productivity field trials

Trials location



Estrées-Mons
INRA centre

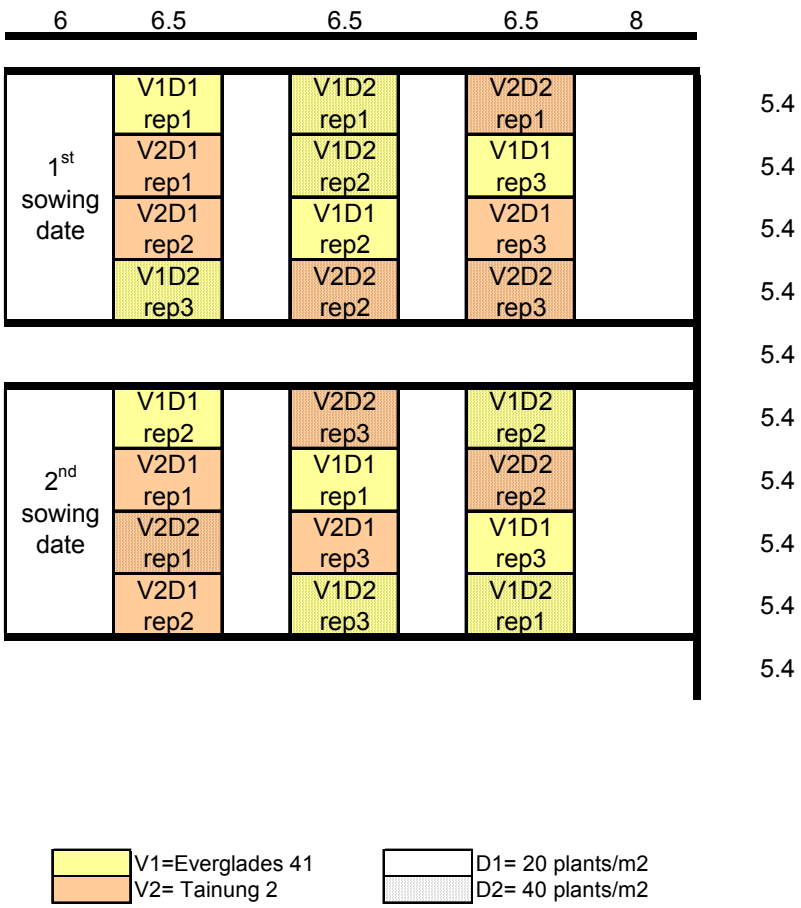
- Oceanic temperate climate
- Soil type: organic clay soil

Flamarens
Agricultural school

- mediterranean-continental climate
- Soil type: sandy clay soil

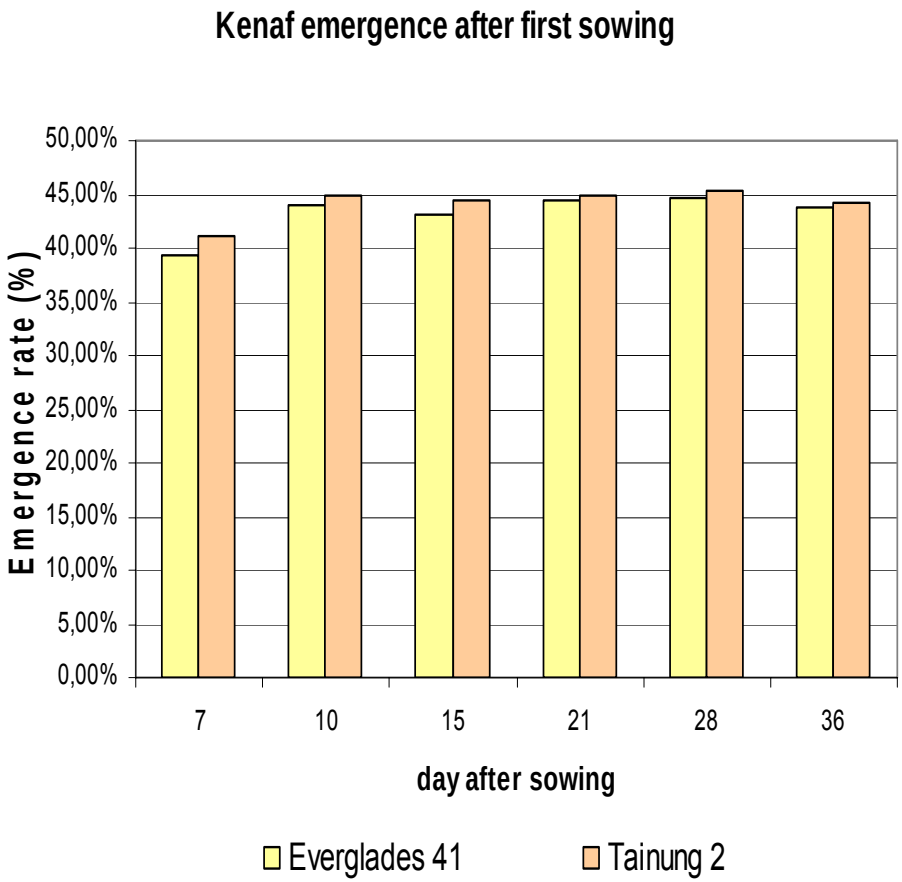
Material and methods

ESTREES-MONS: sowing date-density-variety trial
Experimental design & crop management sequence (1)



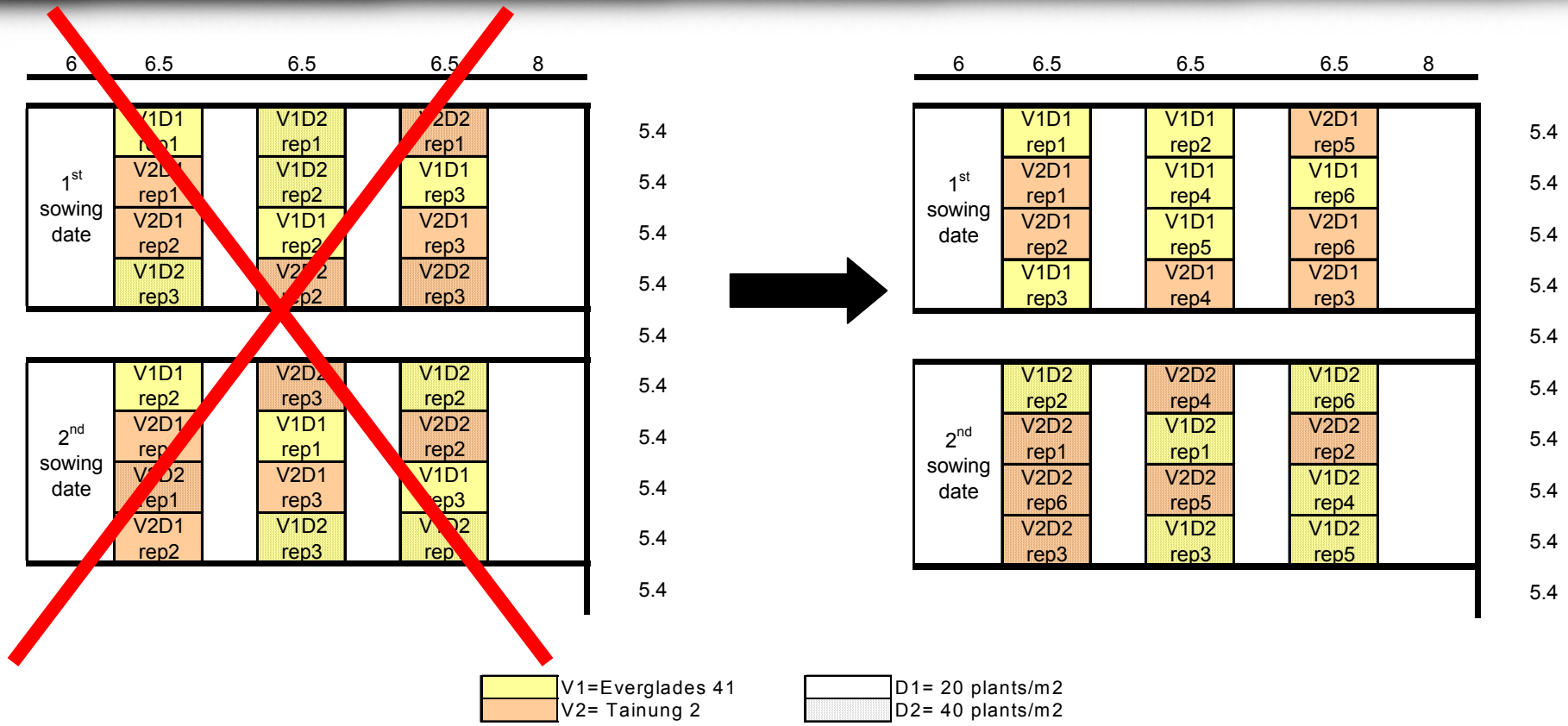
- **Crop management sequence**
- ✓ 1st sowing date (S1): 18/05/2004
- ✓ 2nd sowing date (S2): 15/06/2004
- ✓ Weed control:
  - Beet cultivator
  - 15/06/2004 only on S1
  - 22/07/2004 on S1 and S2
- ✓ Pest management:
  - Aphids (*Myzus persicae*)
  - Karate K®, 1L/ha (Lambda-Cyhalothrine 7.5 g a.i /ha + Pyrimicarbe 150 g a.i/ha)
  - 30/06/2004 only on S1

ESTREES-MONS: sowing date-density-variety trial
Experimental design & crop management sequence (2)



- **For S1:**
  - ✓ sowing density: 40 plants/m2
  - ✓ density observed: 19 plants/m2
- **Germination test**
  - ✓ **Tainung 2:** 91%
  - ✓ **Everglades 41:** 97%
- **Decision for S2:**
  - ✓ sowing density: 80 plants/m2

ESTREES-MONS: sowing date-density-variety trial
Experimental design & crop management sequence (3)

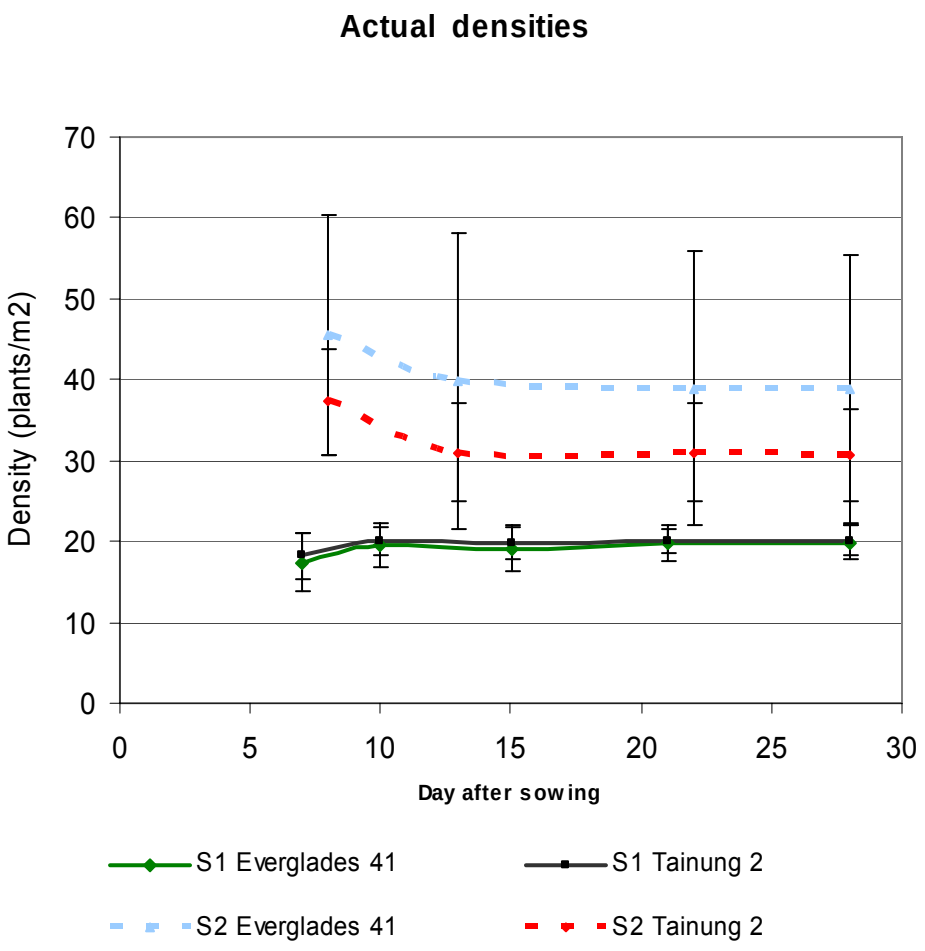


S1: sowing density 40 plants/m2

S2: sowing density 80 plants/m2

Confusion between sowing date effect and sowing density effect

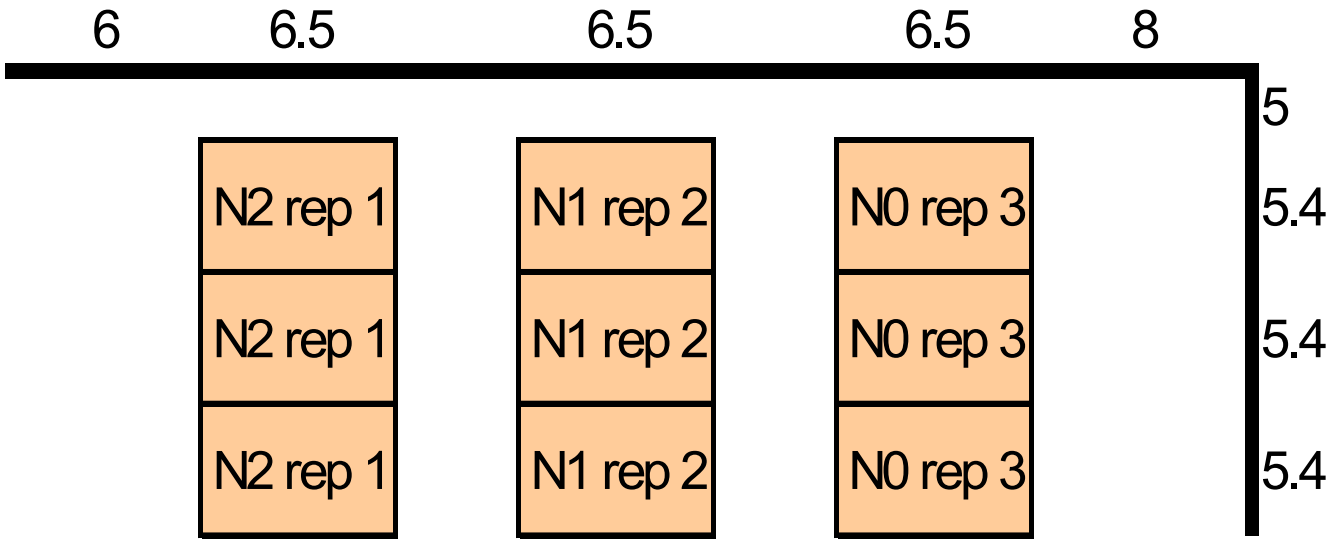
ESTREES-MONS: sowing date-density-variety trial
Actual densities



- **For S1:**
- ✓ sowing density: 40 plants/m2
- ✓ Everglades 41:
  -density observed: 19.4 plants/m2
- ✓ Tainung 2:
  -density observed: 19.6 plants/m2

- ✓ **For S2**
- ✓ sowing density: 80 plants/m2
- ✓ Everglades 41
  -density observed: 38.8 plants/m2
- ✓ Tainung 2
  -density observed: 30 plants/m2

ESTREES-MONS: N-fertilization trial
Experimental design



Trial characteristic

N0: 0 kgN/ha

N1: 100 kgN/ha

N2: 300 kgN/ha

Variety: Tainung 2

Sowing density: 40 plants/m^2

ESTREES-MONS: N-fertilization trial
Crop management sequence

- **Crop management sequence**

✓ 1st sowing date (S1): 18/05/2004

✓ Irrigation: 02/06/2004-45mm

✓ Fertilization: 25/05/2004

✓ Weed control:

- Beet cultivator
- 15/06/2004
- 22/07/2004

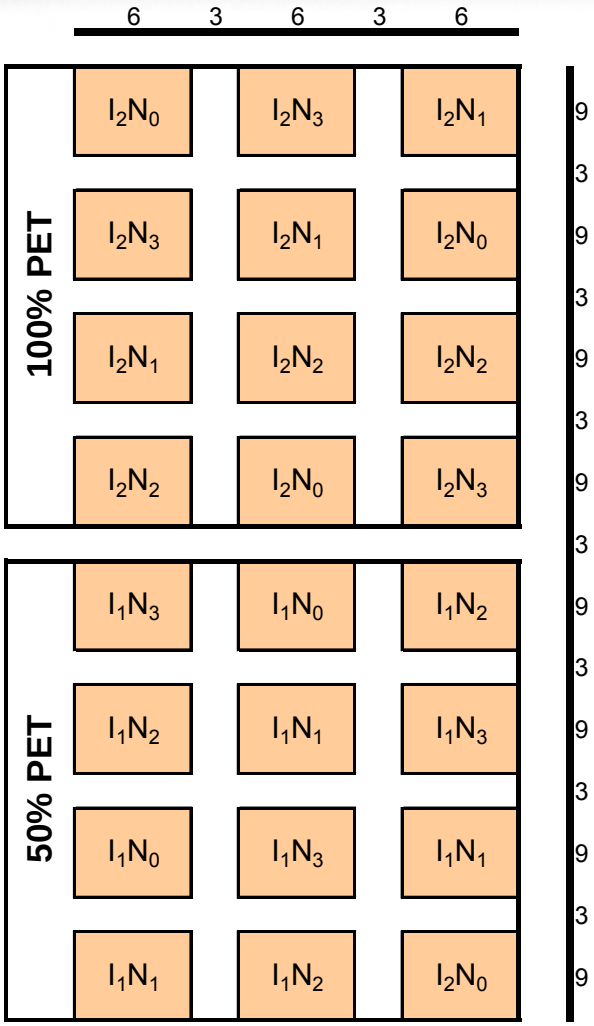
✓ Pest management:

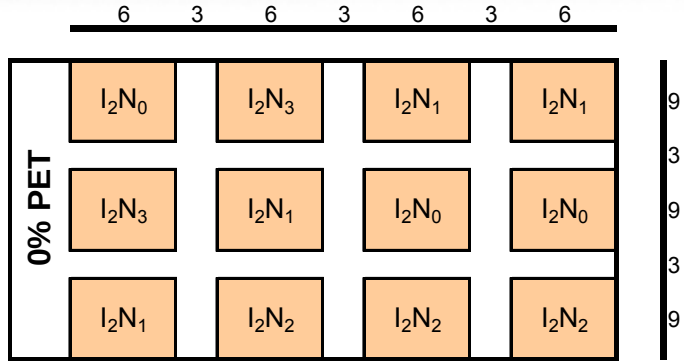
- Aphids (*Myzus persicae*)
- Karate K®, 1L/ha

(Lambda-Cyhalothrine 7.5 g a.i /ha + Pyrimicarbe 150 g a.i/ha)

- 30/06/2004

FLAMARENS:Irrigation-N fertilization trial
Experimental design





Trial characteristic

I0:0% PET

I1:50% PET

I2:100% PET

N0:0kgN/ha

N1:50kgN/ha

N2:100kgN/ha

N3:150kgN/ha

Variety: Tainung 2

Sowing density: 35 plants/m^2

FLAMARENS:Irrigation-N fertilization trial
Crop management sequence

- **Crop management sequence**

✓ Sowing date: 03/06/2004

✓ Fertilization:

- 20/05/2004: 75 kg/ha P_2O_5+75 kg/ha K_2O
- 01/09/2004: N fertilization

✓ Irrigation (100% PET):

- 08/07/2004: 25 mm

✓ Weed control:

- No weed control before 05/09/2004
- ↳ Massive competition between weeds and kenaf
- Targa® 1.2 L/ha (150 g a.i./ha quizalofop ethyl)

Data already collected

- **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)**
  - Dry matter yield (harvest row=2 m):
    - On leaf and stems
    - Total
  - Leaf Area Meter

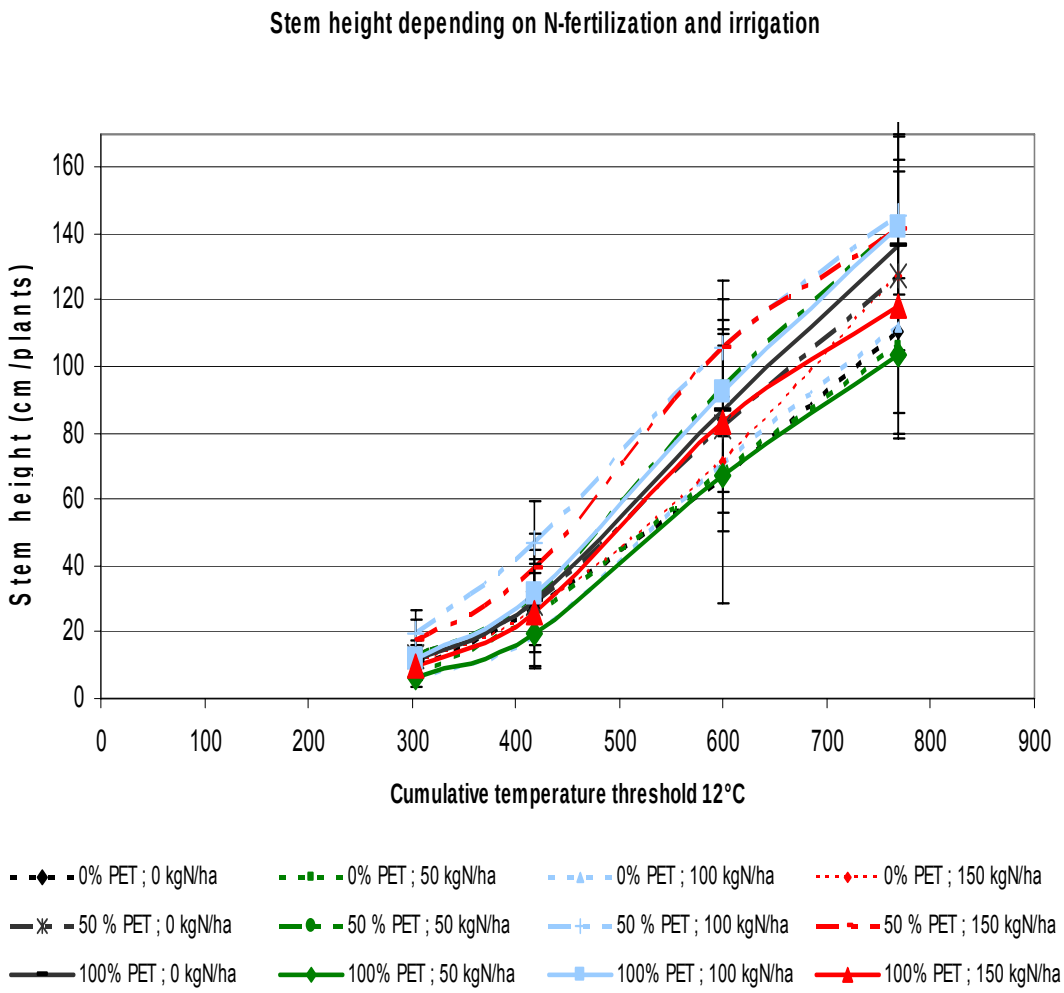
Results

ESTREES-MONS:sowing date-density-variety trial

ESTREES-MONS: N-fertilization trial

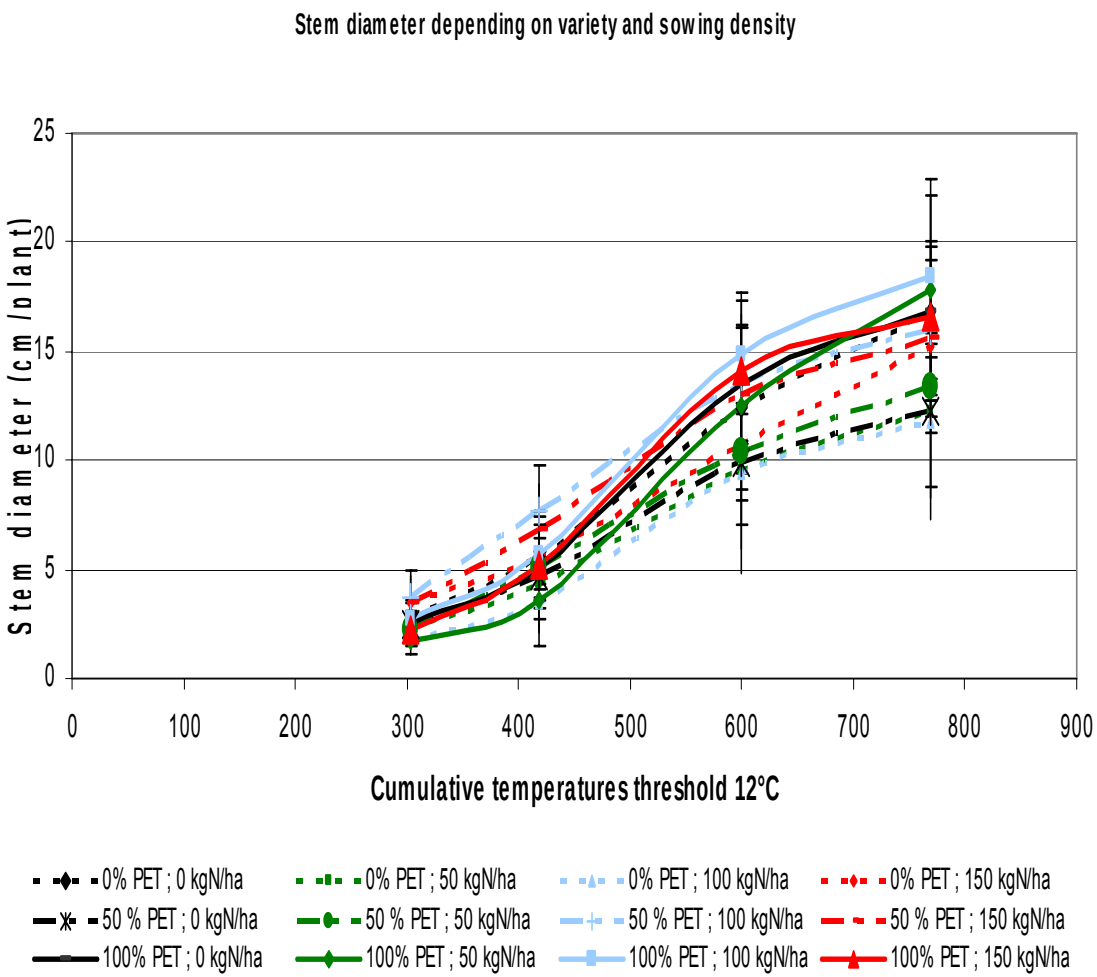
FLAMARENS: Irrigation and N-fertilization trial

FLAMARENS: Irrigation and N-fertilization trial
Growth data-Stem height



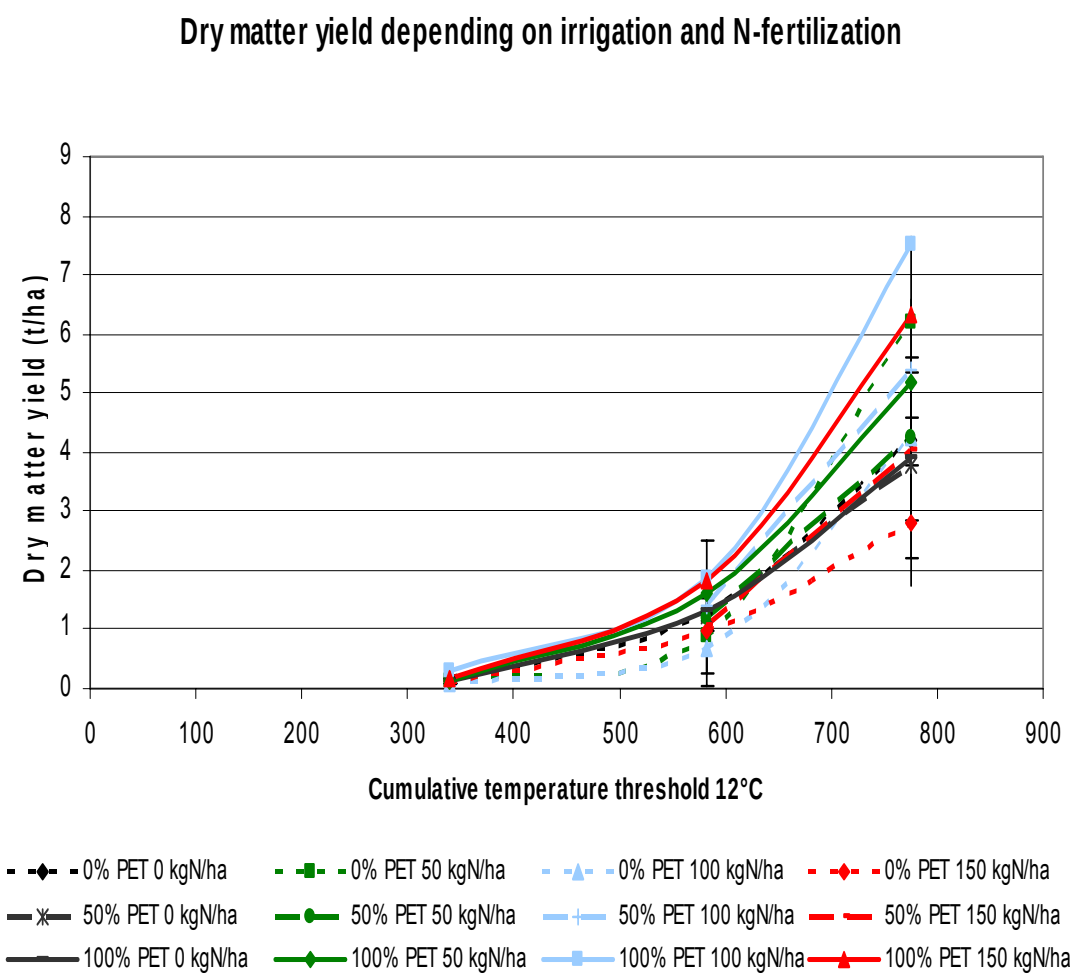
- **Irrigation effect**
  - Not obvious
- **N-fertilization effect**
  - Not obvious
- **Stem height in August**
  - Average value: 127.26 cm

FLAMARENS: Irrigation and N-fertilization trial
Growth data-Stem diameter



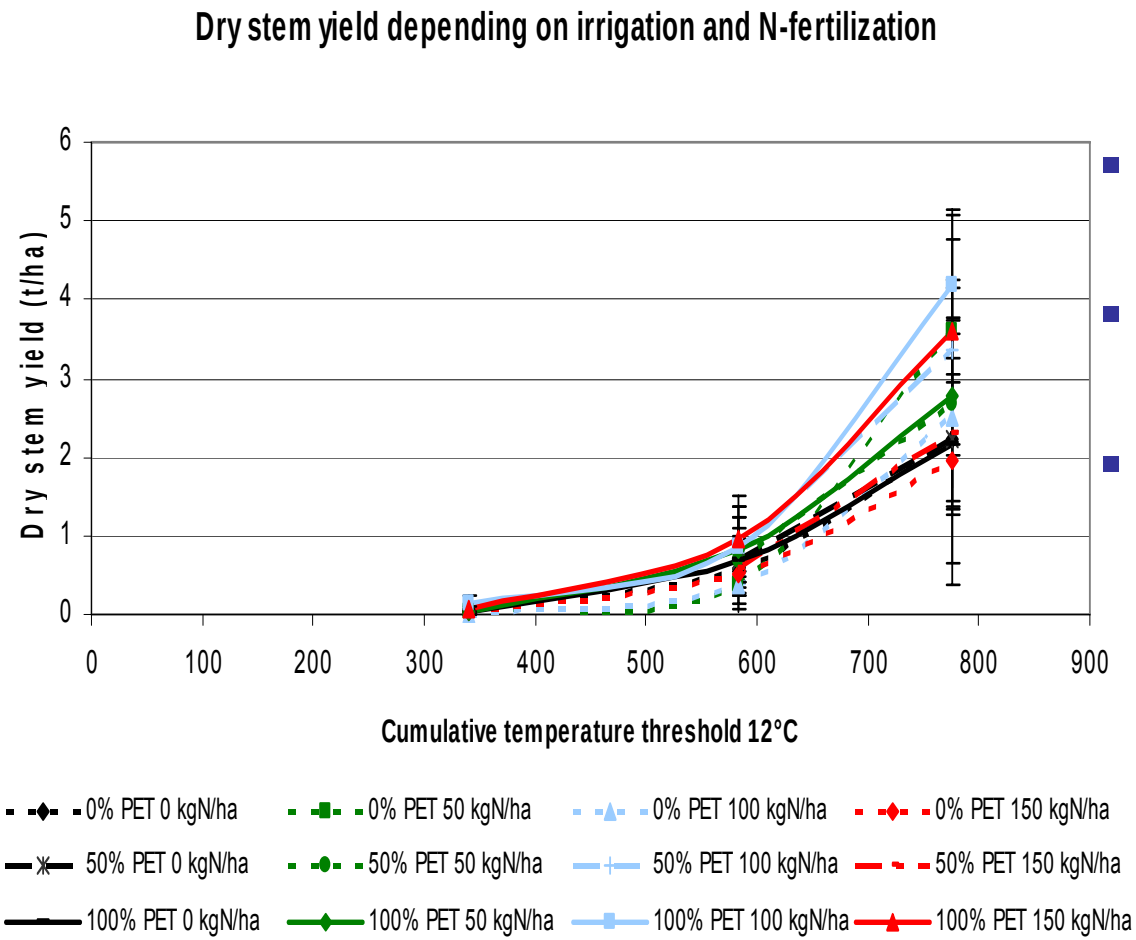
- **Irrigation effect**
  - Not obvious
- **N-fertilization effect**
  - Not obvious
- **Stem diameter in August**
  - Average value: 15.25 mm

FLAMARENS: Irrigation and N-fertilization trial
Productivity data-Dry matter yield



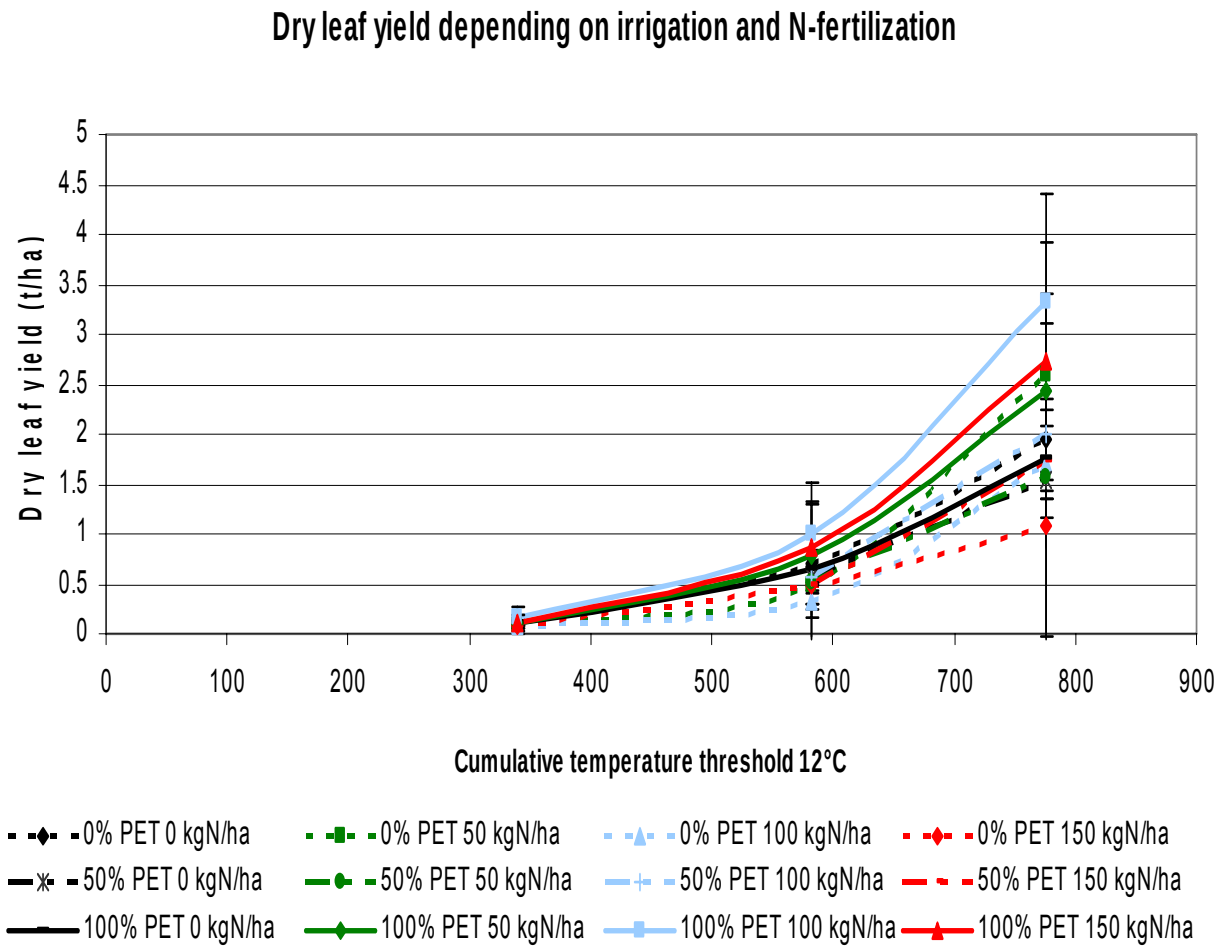
- **Irrigation effect**
  - Not obvious
- **N-fertilization effect**
  - Not obvious
- **Dry matter yield in August**
  - Average value: 4.9 t/ha

FLAMARENS: Irrigation and N-fertilization trial
Productivity data-Dry stem yield



- **Irrigation effect**
  - Not obvious
- **N-fertilization effect**
  - Not obvious
- **Dry stem yield in August**
  - Average value: 2.8 t/ha

FLAMARENS: Irrigation and N-fertilization trial
Productivity data-Dry leaf yield



- **Irrigation effect**
  - Not obvious
- **N-fertilization effect**
  - Not obvious
- **Dry leaf yield in August**
  - Average value: 2.1 t/ha

Trial conclusions

- **Sowing effect**
  - Statistical effect noticed
  - Impossible to conclude on density and sowing date effect, because of confusion between both
- **Variety effect**
  - No major differences between varieties except the height (Tainung 2 > Everglades 41)
- **N-fertilization effect**
  - Slight differences noticed in Estrées-Mons
  - No statistical differences
- **Irrigation effect**
  - Not obvious this year, probably because of competition between weeds and kenaf

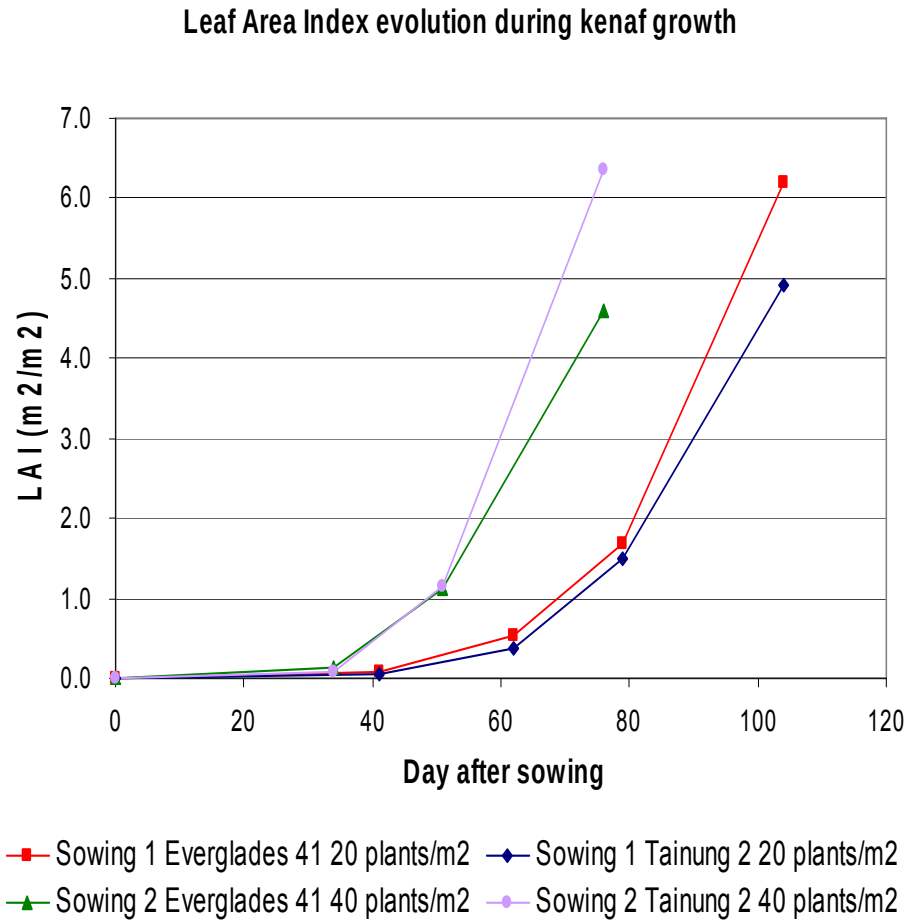
WP3 : Development of the crop growth simulation model

Determination of Radiation Use Efficiency (RUE)

- **Dry matter yield (t/ha) = RUE × Intercepted Photosynthetic Active Radiation (PAR) (MJ/m^2)**

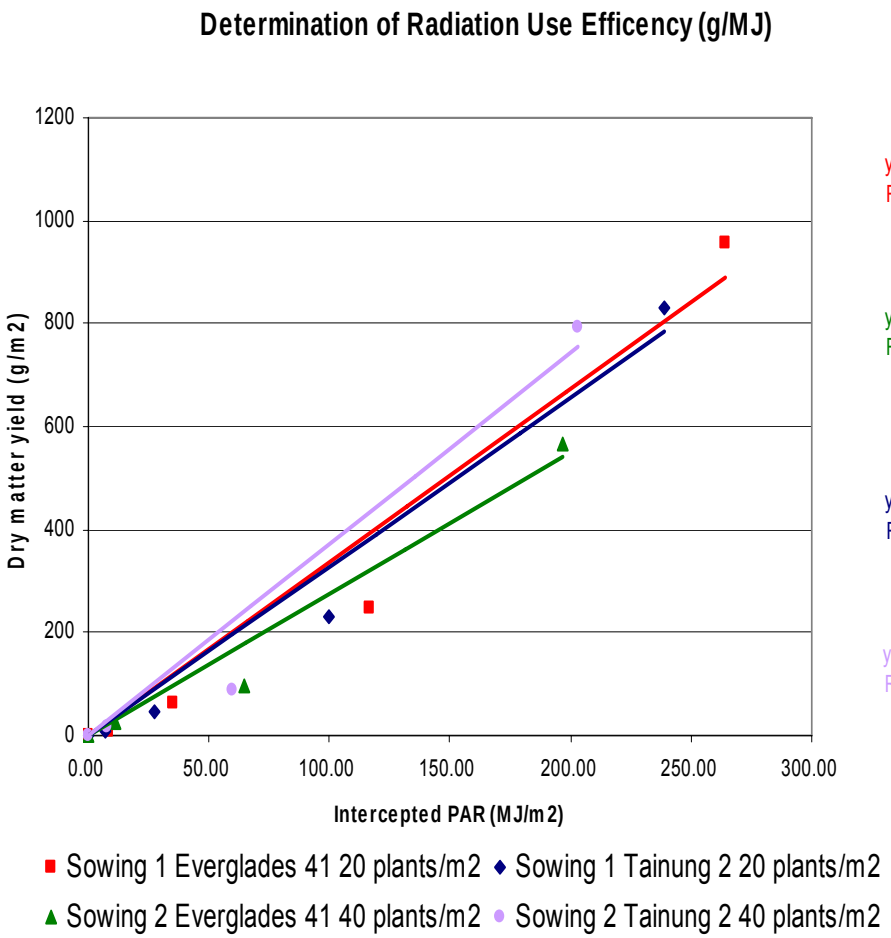
- **Calculation of intercepted PAR**
  - Leaf Aera Index (LAI) = $\sum a \times \Delta t$
    - LAI: m^2/m^2
    - Δt: days
    - a: (m^2/m^2)/day
  - $\varepsilon_i = 0.95 \times (1-\exp^{(-k \times LAI)})$
    - k=0.56 (MUCHOW R.C. 1992. Effect of water and nitrogen supply on radiation interception and biomass accumulation of kenaf (Hibiscus cannabinus) in a semi-arid tropical environnement. Field Crop Research. Vol 28. N°4. pp 281-293)
  - (PAR) =0.5×Global Radiation (GR)
  - Intercepted PAR = $\sum \varepsilon_i \times PAR$

Leaf Aera Index evolution
Sowing date-density-variety trial results



- LAI values
  - 2003 (S1-20 plants/m2) :
    - Everglades 41: 2.9
    - Tainung 2: 3.9
  - 2004 (S1-20 plants/m2)
    - Everglades 41: 6.2
    - Tainung 2: 4.9

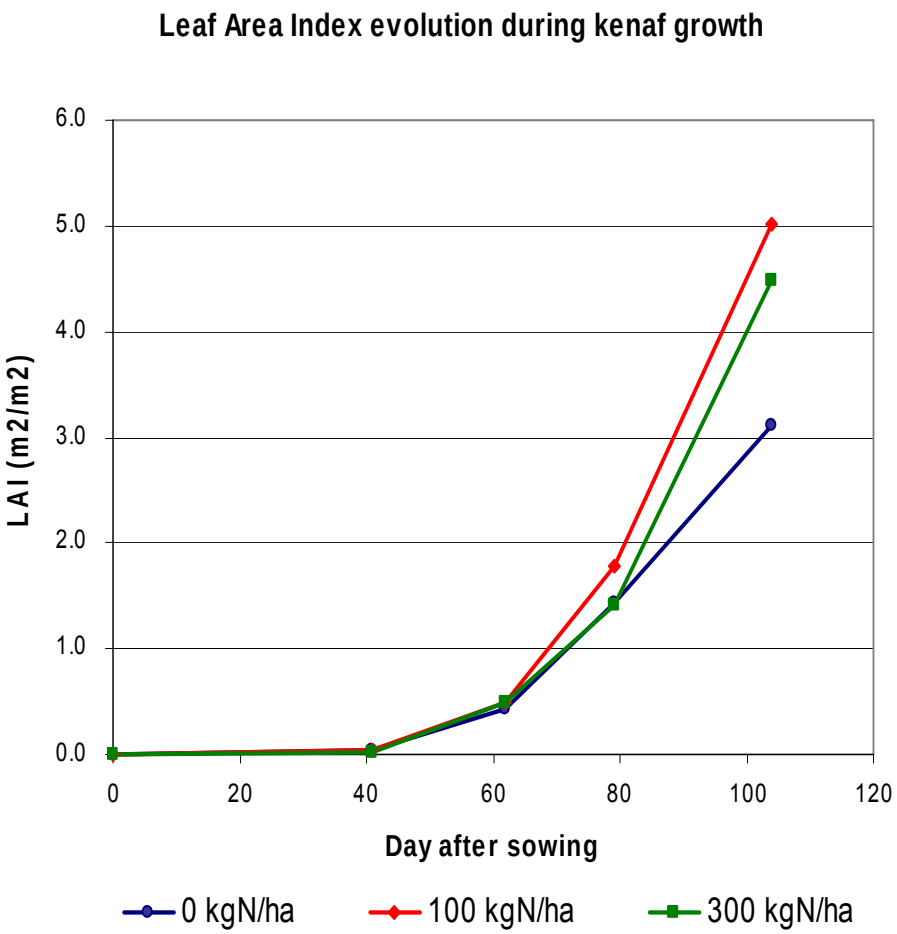
Determination of Radiation Use Efficiency
Sowing date-density-variety trial results



- Radiation Use efficiency:
  - 2003 (S1-20 plants/m2) :
    - Everglades 41: 1.46 g/MJ
    - Tainung 2: 1.46 g/MJ
  - 2004 (S1-20 plants/m2) :
    - Everglades 41: 3.3 g/MJ
    - Tainung 2: 2.75 g/MJ
  - Muchow value: 2.4 g/MJ

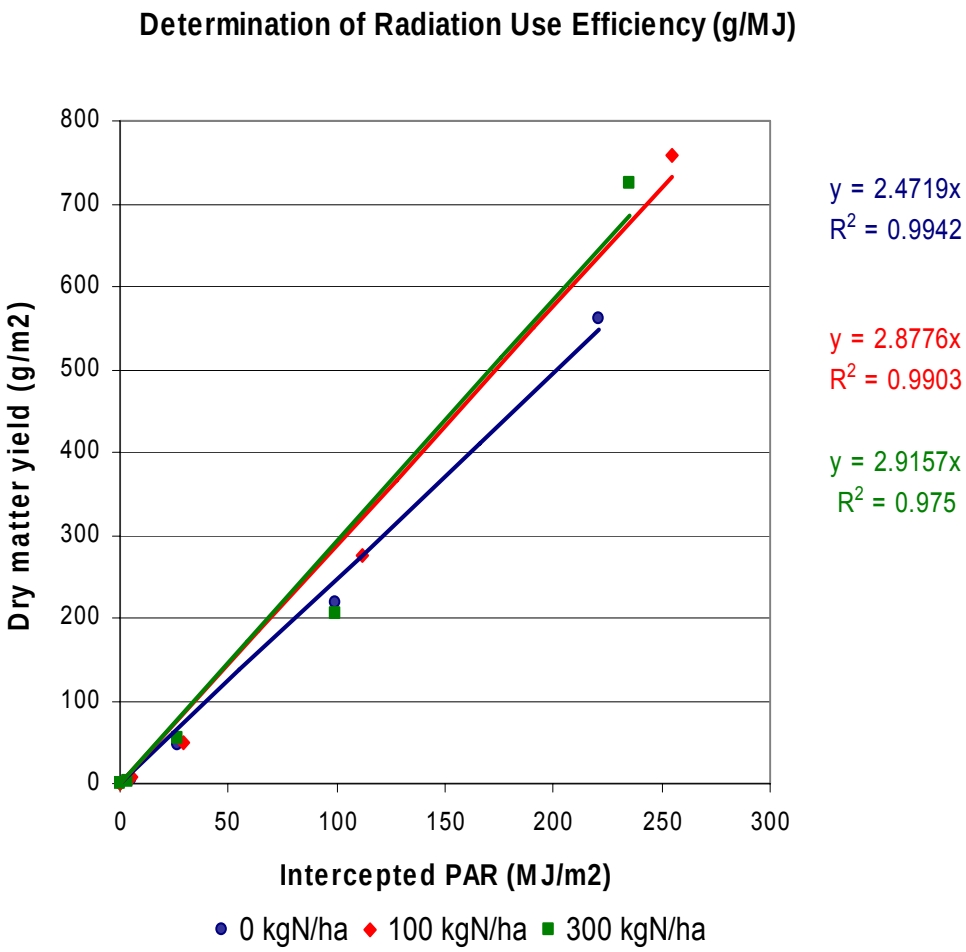
↳ Lower density: 18 plants/m^2

Leaf Aera Index evolution
N-fertilization trial results



- LAI values
  - N1;N2 > N0
  - Statistical differences

Determination of Radiation Use Efficiency N-fertilization trial results

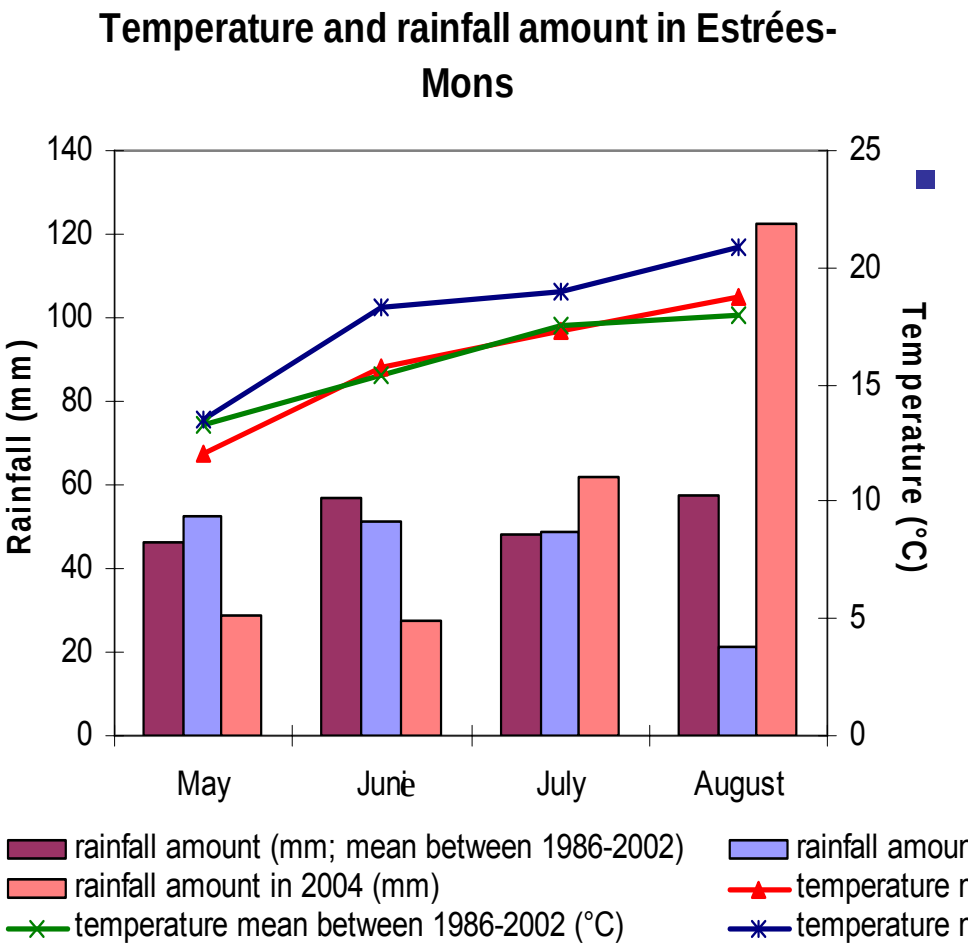


- Radiation Use Efficiency:
  - Lower than those observed in the sowing date-density-variety trial

L'INRA : pour la Terre et les hommes

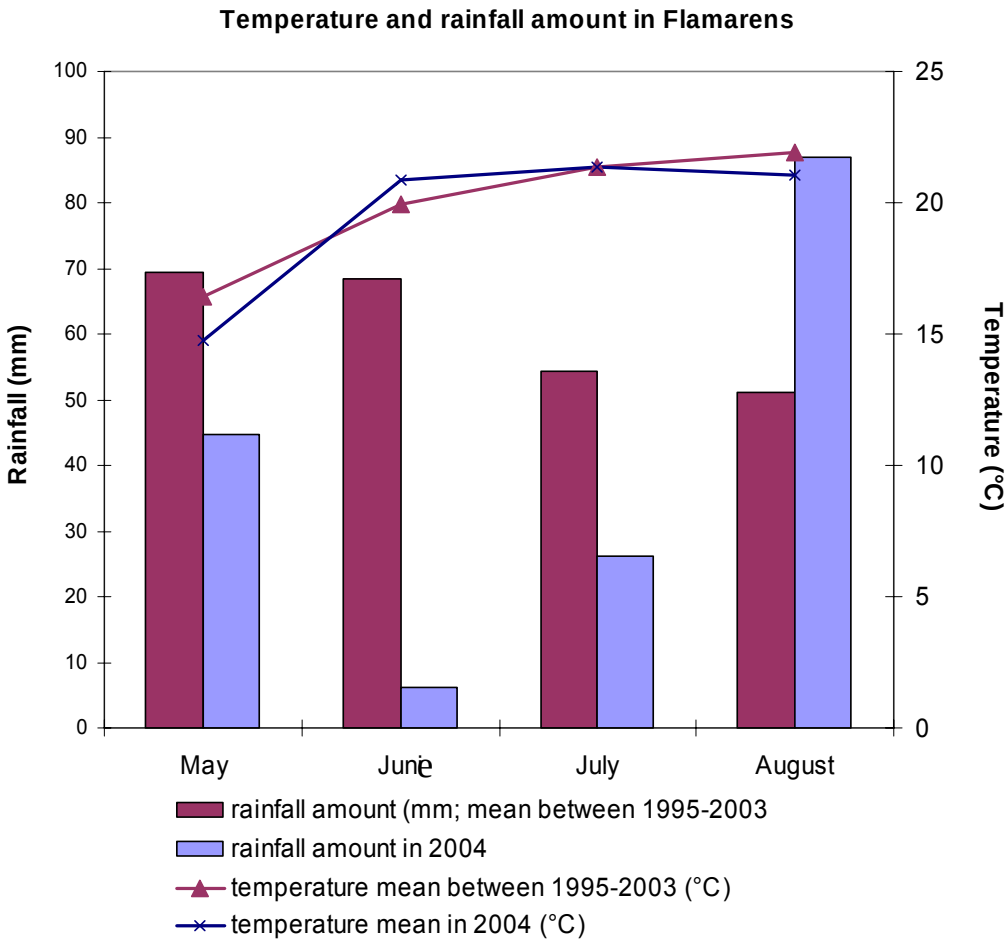
une recherche publique finalisée

ESTREES-MONS:meteorological data



- **2004:**
  - Temperature: as usual
  - Rainfall: higher than usual
    - 122 mm in August
    - 60 mm in July
    - No drought this year

FLAMARENS:meteorological data



- **2004:**
  - Temperature: as usual
  - Rainfall: higher than usual in August