WP2. Adaptability and Productivity Field Trials

Results from the period 1/4/04-today

E. Alexopoulou
CRES
Biomass Department

WP2. Adaptability and Productivity Trials

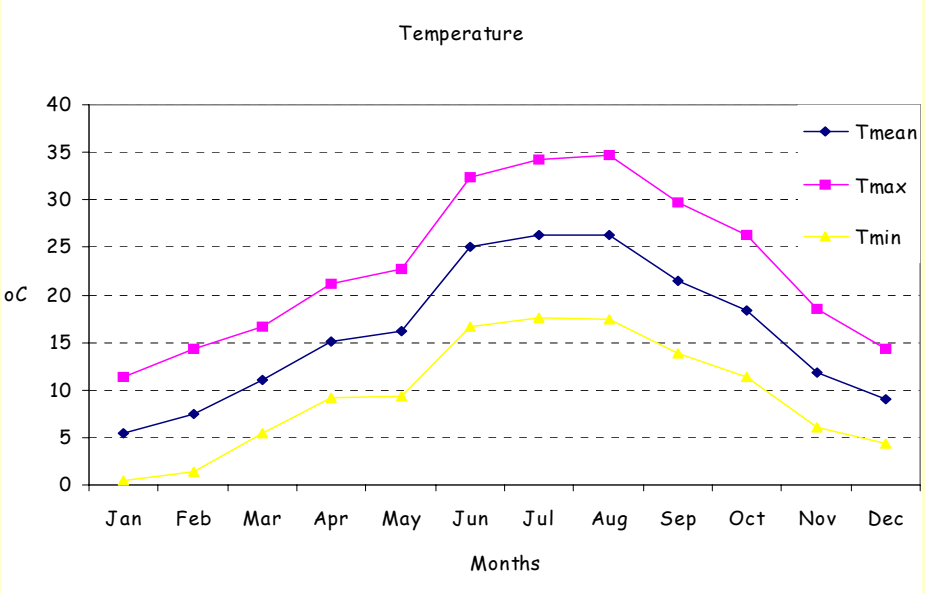
In the second year of the project three kenaf field trials were established in Aliartos (central Greece).

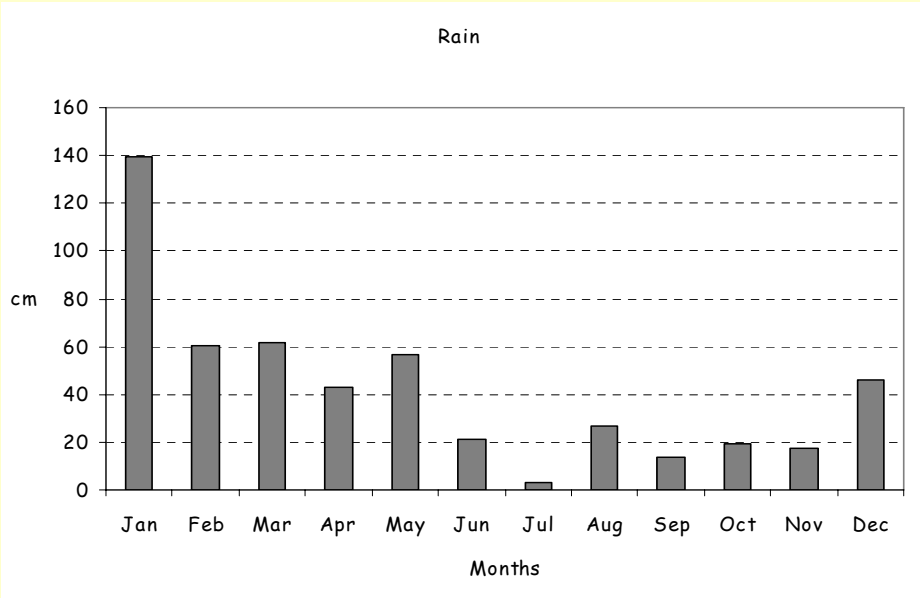
- Task 2.1: Screening trial
- Task 2.2: Effect of sowing dates and plant populations on biomass yields
- Task 2.3: Effect of irrigation and nitrogen fertilisation on biomass yields

Established trials in the second year of the project

Organization	Country	Kenaf trials
CRES	Greece	• Screening trial • Sowing dates and plant densities • Irrigation and fertilization trial
UTH	Greece	• Sowing dates and plant densities • Irrigation and fertilization trial ***(in two sites)***
University of Catania	Italy	• Sowing dates and plant densities • Irrigation and fertilization trial
University of Bologna	Italy	• Sowing dates and plant densities • Fertilization trial
CETA	Italy	• 2 ha field trial
INIA	Spain	• Sowing dates and plant densities **(in two sites)** • Irrigation and fertilization trial
UniNOVA	Portugal	• Sowing dates and plant densities • Irrigation and fertilization trial
INRA	France	• Sowing dates and plant densities • Irrigation and fertilization trial

Daily temperature (^{0}C) (max, min and average) and monthly precipitation (mm) for the period 1/1/04 to 31/12/04



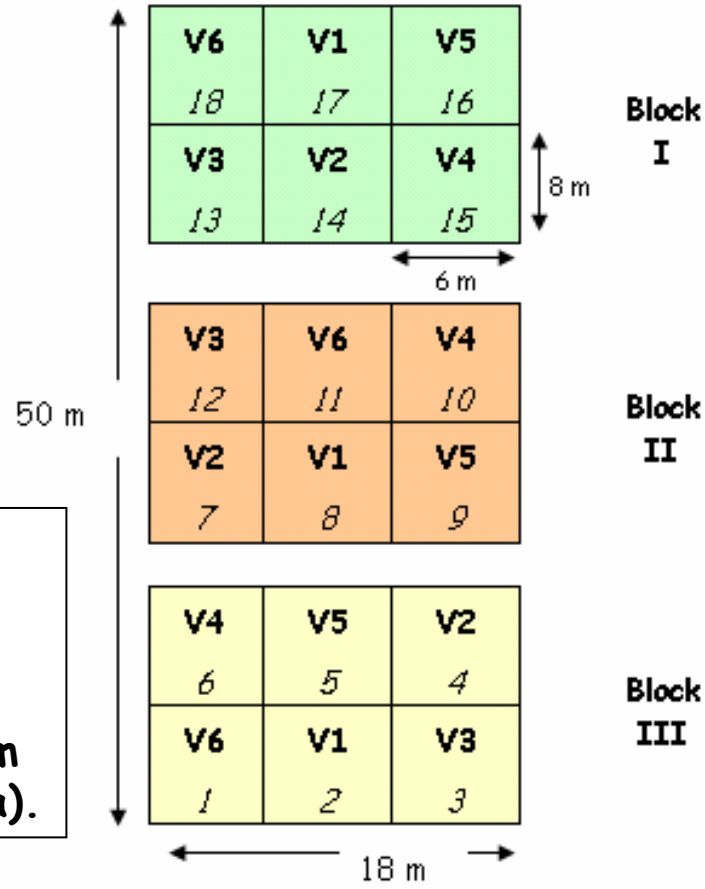


Experimental layout of Task 2.1
Screening trial

Sowing date: 13/5/04 (by hand)

Emergence date: 18/5/04

Thinning date: 14/6/04



V1: Tainung 2
V2: Everglades 41
V3: Gregg
V4: Dowling
V5: SF 459
V6: G4

5 marked plants/plot was used for height and stem diameter measurements

The distances between the rows were 50 cm and within the rows 10 cm (200,000 pl/ha).

Harvest dates: 12/7/04, 3/8/04, 25/8/04, 13/9/04, 4/10/04, 25/10/04, 15/11/04, 28/11/04, 14/12/04

* The six tested varieties were:

Everglades 41

late variety that produce reasonable fiber production and a cotton-like leaf shape

Tainung 2

late variety, with superior raw fiber production and palmate leaf shape

Gregg

is a new variety with slightly longer growing period that may contributes to greater fiber production and palmate leaf shape

Dowling

new variety, that may prove to be a very high fiber producer with non-palmate leaf shape

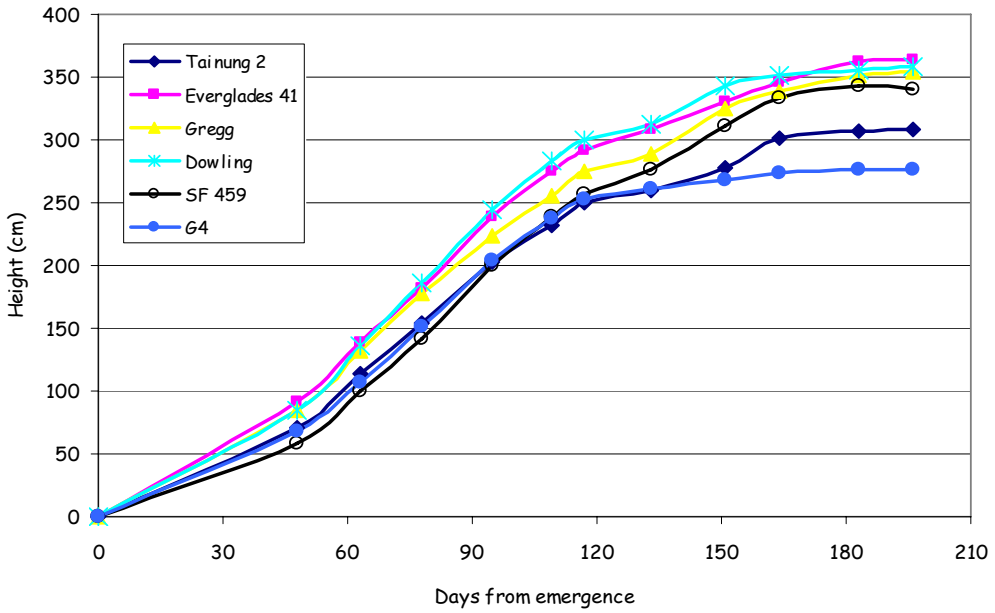
SF 459

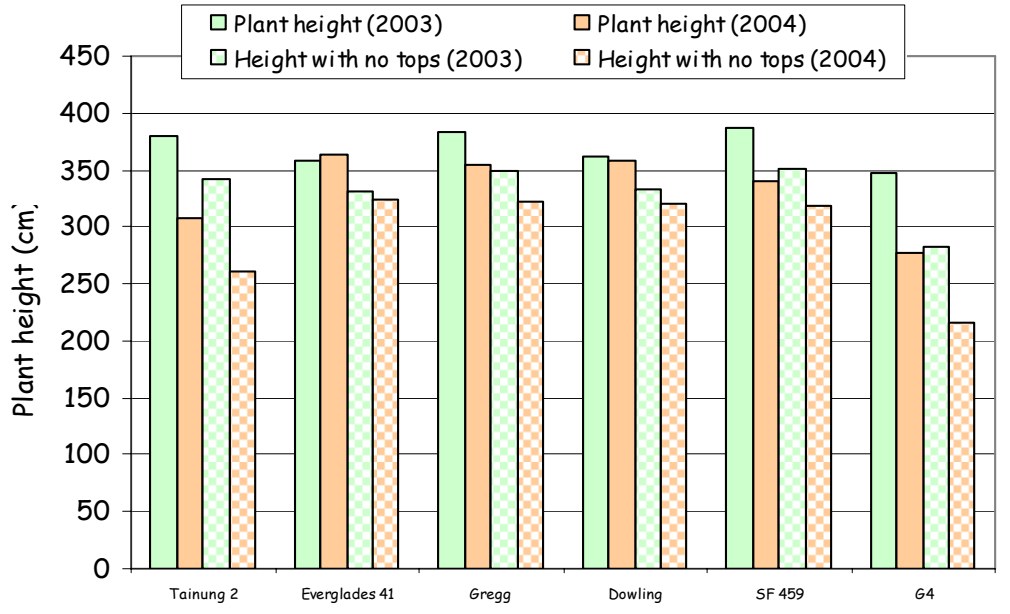
new variety that is favored for soils with nematode problem and palmate leaf shape

G4

it is considered as a photoperiod-insensitive variety that combines a short maturity cycle (100-130 days between emergence and flowering) and high productivity when grown in the Mediterranean region)

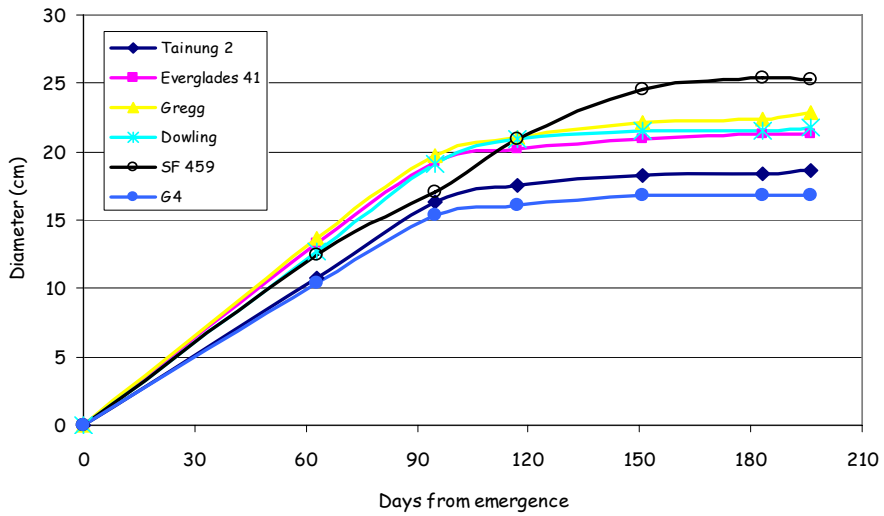
Final plant height (cm)
with or without the upper part of the stems with flowers

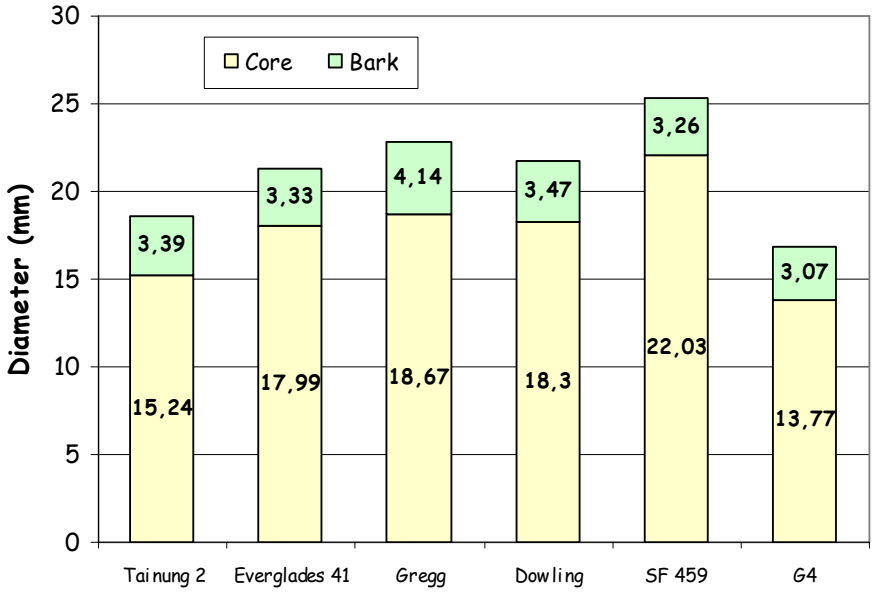




- At the end of the growing season the plant height ranged from **277 cm (G4)** to **364 cm (Everglades 41)**
- Only G4 plants managed to mature their seeds (the flowering started in August)
- In the second year (2004) all varieties produced shorter plants compared to the ones of 2003 (11%). So, the mean plant height was **334 cm in 2004**, while in **2003 was 370 cm**. The corresponding values for the plants without the tops were 294 and 332 cm.

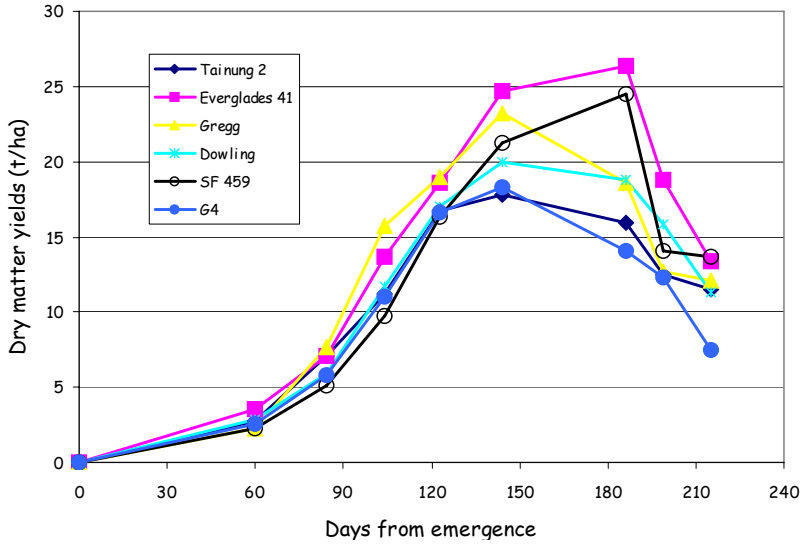
Basal stem diameter (mm) whole stem and for both stem fractions (bark and core)

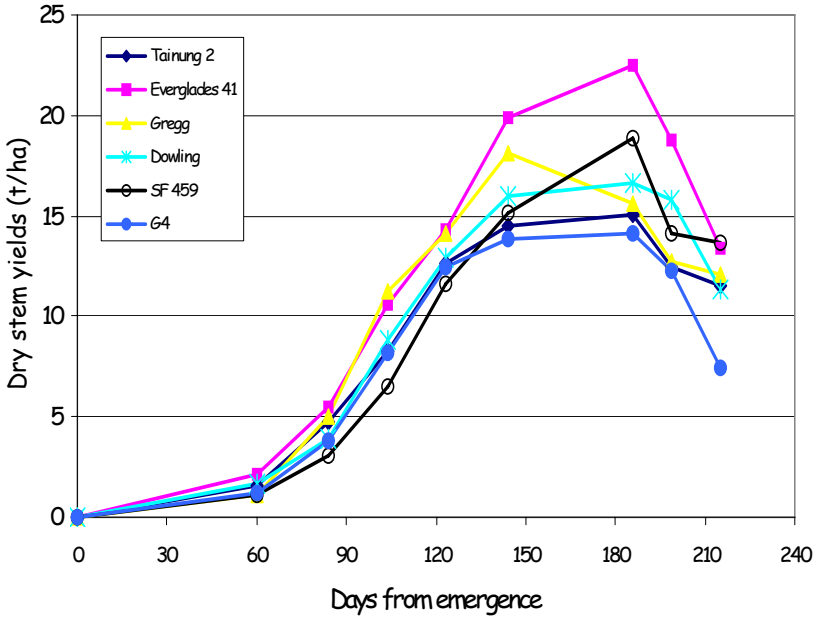




- In November 2004 the stem diameter by descending order was **25.3 mm for SF 459, 22.8 mm for Gregg, 21.8 mm for Dowling, 21.3 mm for Everglades 41, 18.6 mm for Tainung 2 and 16.8 mm for G4**
- Averaged overall varieties, the mean stem diameter in 2004 was 21.1, while in 2003 was 20 mm. The corresponding values for the core were 17.7 and 16.9 mm.

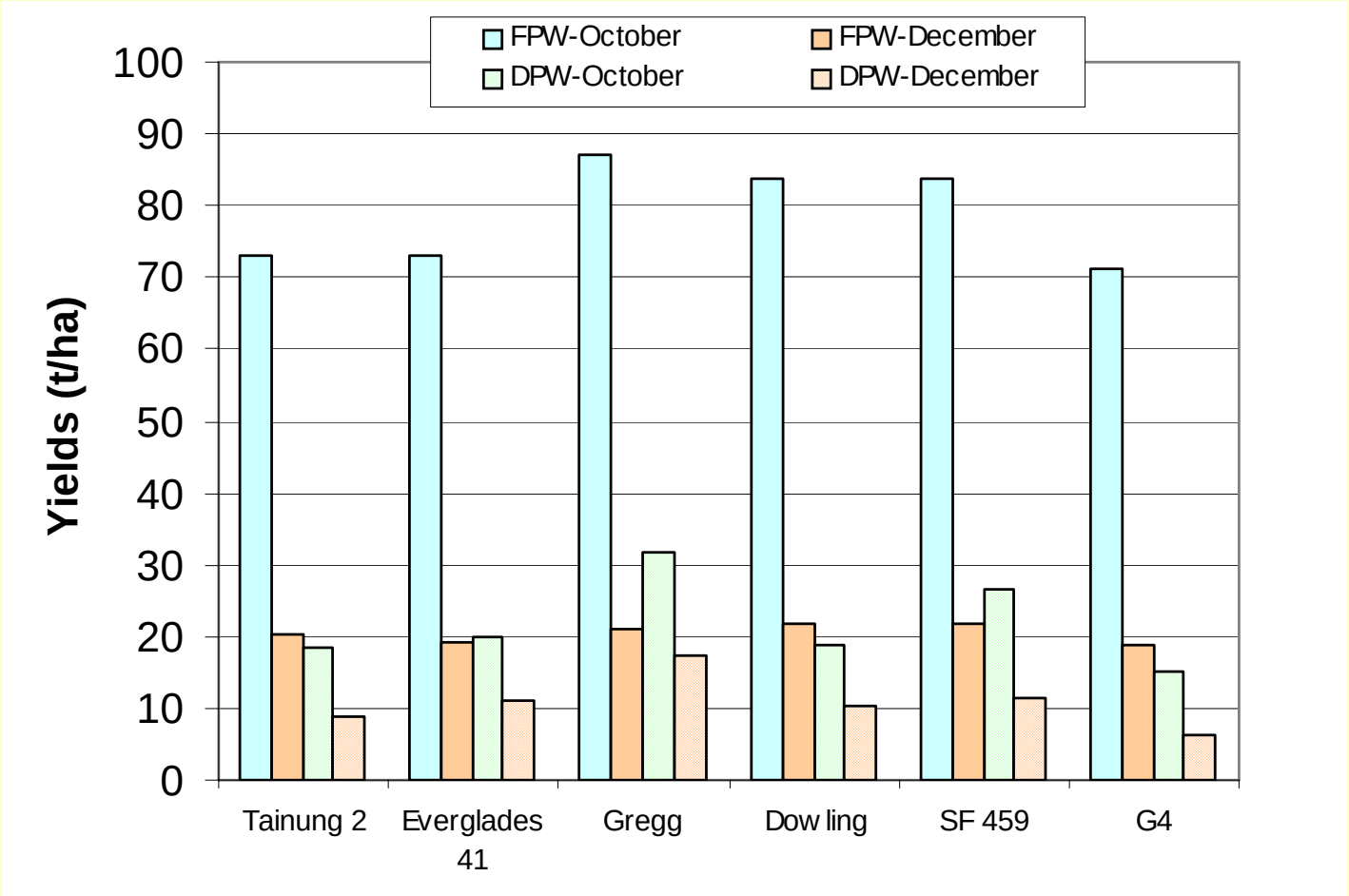
Accumulation of dry yields (total and stem)





- The pick dry yields were recorded in the middle of November 2004 and were 19.7 t/ha, averaged overall varieties. Then the highest yields were recorded by Everglades 41 (26.4t/ha) and the lowest ones by G4 (14.1t/ha).
- One month later, at the final harvest, the dry yields had been reduced and were 12.7 t/ha.
- It should be pointed out that in the middle of November and stems had still leaves and the moisture content was less than 25%, while at the final harvest the stems had been defoliated and the moisture content was less than 40%

Fresh and dry stem yields (t/ha)
Comparison between October and December (5 m2 harvest)

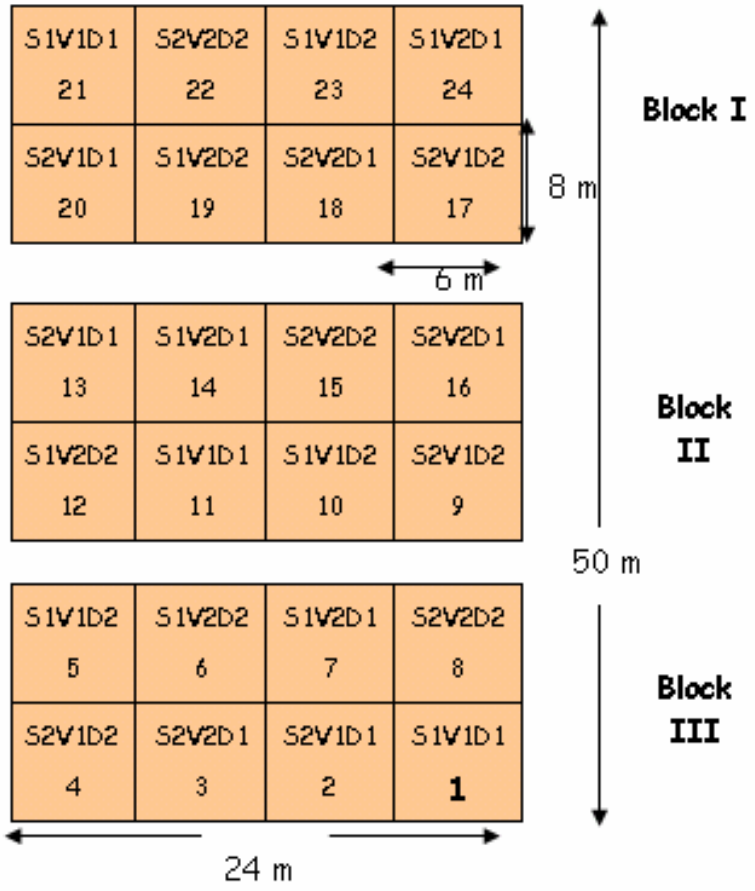


The mean dry yields **in October was 22 t/ha**, while **in December was 11 t/ha**. In both cases, the highest yields were recorded for the variety Gregg and were 31.7 t/ha in October and 17.4 t/ha in December. The lowest yields in both cases was recorded by G4 and were 15.2 in October and 6.2 t/ha in December.

Conclusions from the nursery trial

- The highest plants were developed **by variety Everglades 41 (364 cm),** while the lowest ones were **by G4 (277 cm)**.
- At the same time three out the larger stems where developed by the variety **SF 459 (25.3 mm),** while the smallest stems where from the variety **G4 (16.8mm)**.
- The pick dry yields were recorded in the middle of November and ranged from **14.1 t/ha (G4) to 26.4 t/ha (Everglades 41)**
- At the final harvest (middle of December 2004) the dry matter yields by descending order were **13.7 (SF 459),** 13.4 t/ha (Everglades 41), 12.1 t/ha (Gregg), 11.5 t/ha (Everglades 41) and 7.5 t/ha (G4).
- It should be pointed out that **statistical significant differences** were recorded for the measured parameters among the tested varieties (LSD Test, $P<0.05$) at the final stages of the growing period (after the flowering phase).

Experimental layout of Task 2.2
Sowing times and plant populations



Treatments:

S1:18/5/03, S2: 7/6/03

V1: Tainung 2, V2: Everglades 41

D1: 200,000 pl/ha, D2: 400,000 pl/ha

Dates of sowing:

S1:30/4/04

S2: 25/5/04

Dates of emergence:

S1:4/5/04

S2: 29/5/04

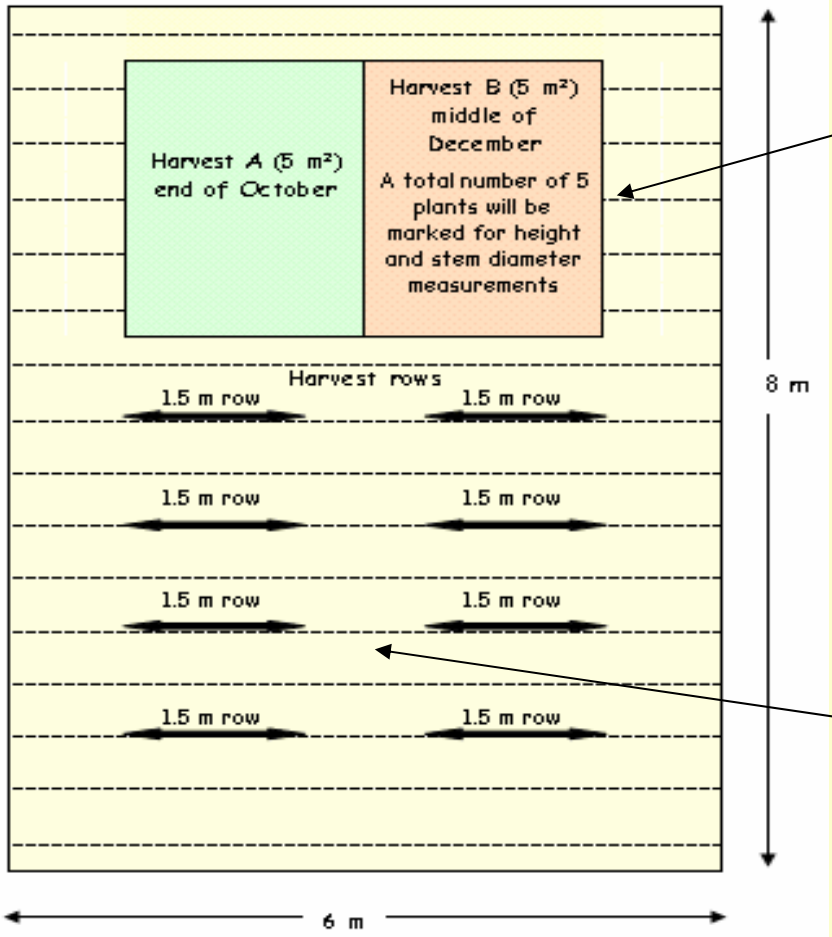
Dates of thinning:

S1:5/6/04

S2: 22/6/04

A quantity of 75 kg N/ha was applied through the drip irrigation system at the end of June

Experimental plot of Task 2.2
Sowing times and plant populations



- The size of each plot will be 6x8m (48m²)
- The distance between the rows will be 50 cm and within the rows 5 cm for the density of 400,000 plants/ha and 10 cm for the density of 200,000 plants/ha.
- A total number of 16 rows will be sown in each plot.

The plant height was measured on five marked plant per plot every two weeks, while on the same plants the basal stem diameter was measured every four weeks.

Harvest dates:

12/7/04

3/8/04

25/8/04

13/9/04

4/10/04

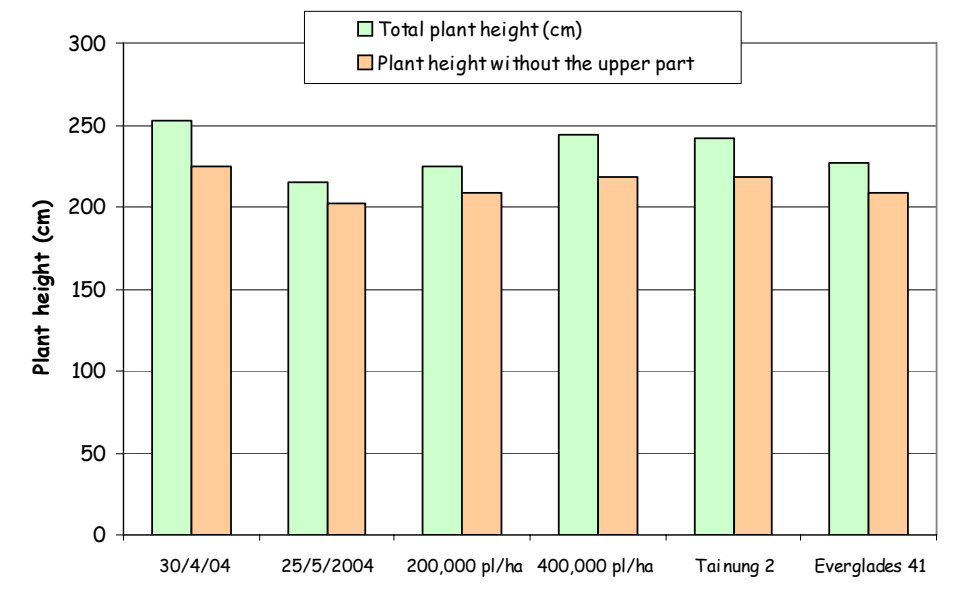
25/10/04

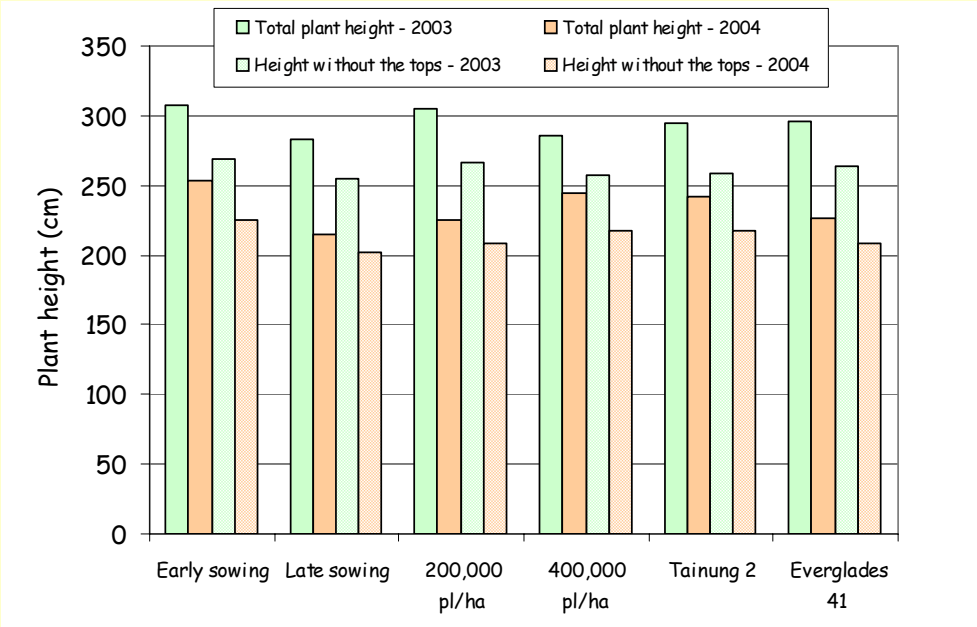
15/11/04

28/11/04

14/12/04

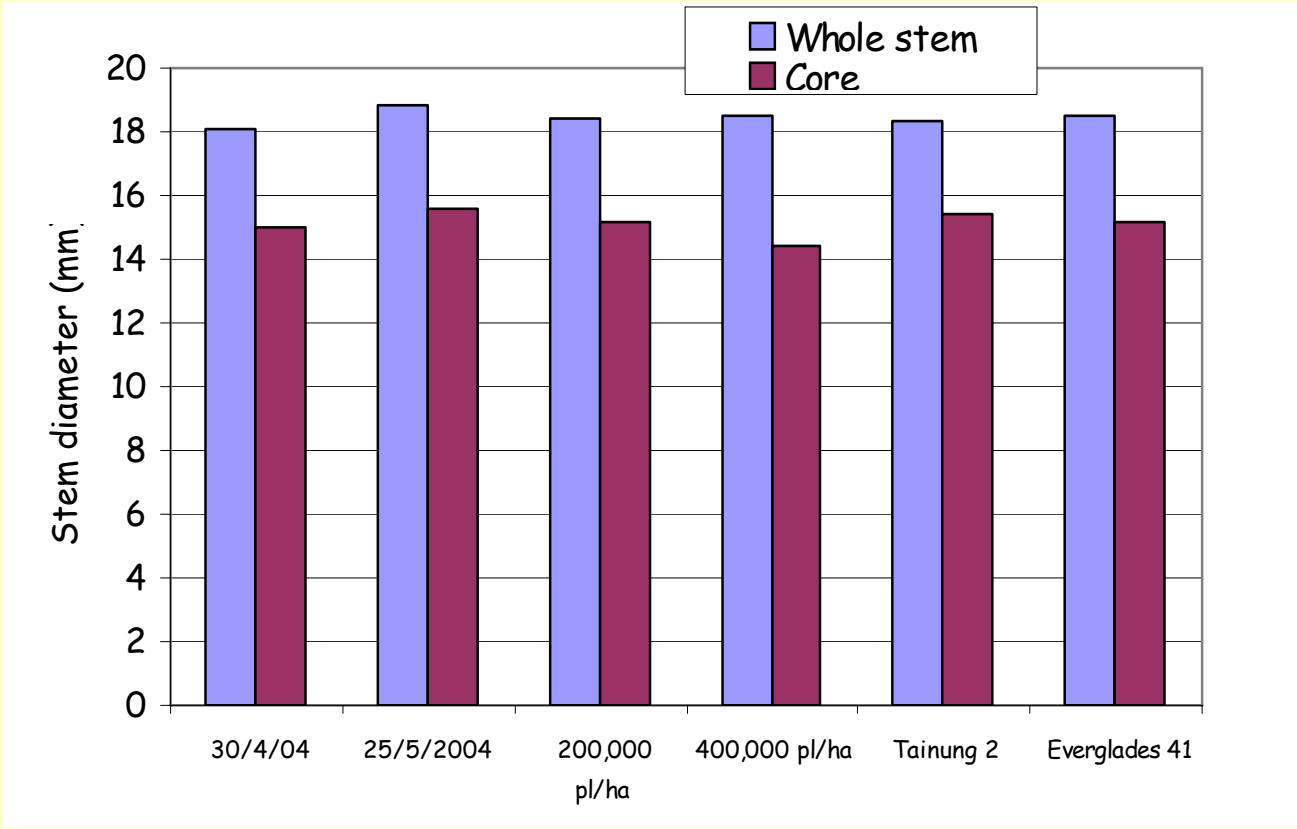
Final plant height (cm) with or without the tops in 2004 and comparison between 2003 and 2004





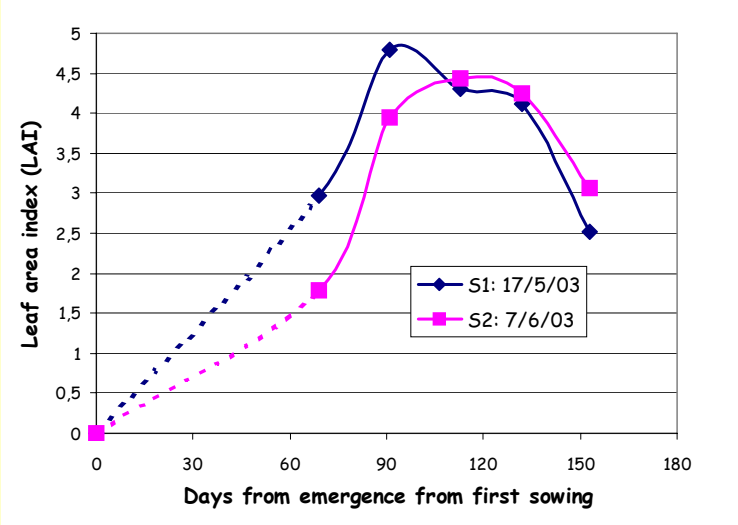
- The early sowing gave higher plants compared to the late one (253 cm versus to 215 cm).
- The plots with the low density gave shorter plants (225 cm) compared to the ones that grew up in the denser plots (244 cm).
- A superiority in terms of plant height of Tainung 2 (242 cm) over Everglades 41 (227 cm) was recorded
- A comparison between the plant height values of 2003 and 2004 showed that the plants that grew up in 2003 were almost 20% higher compared to the ones that grew up in 2004

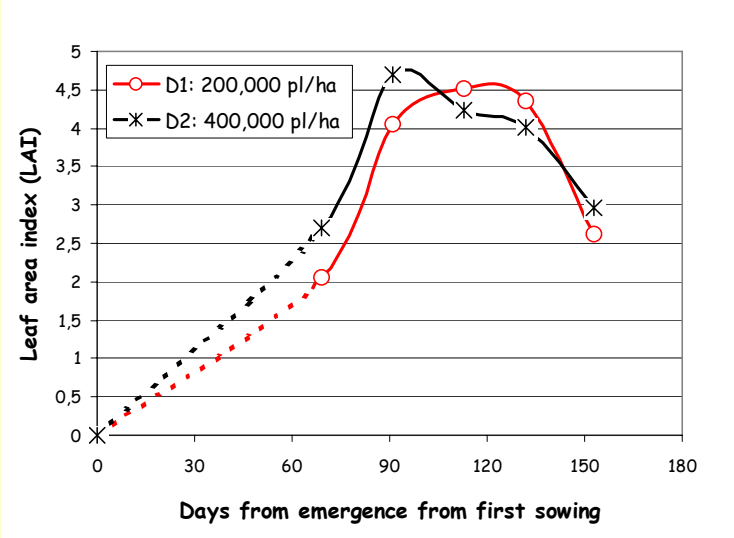
Final stem diameter (mm) for the whole stems and for the stems without the bark in 2004

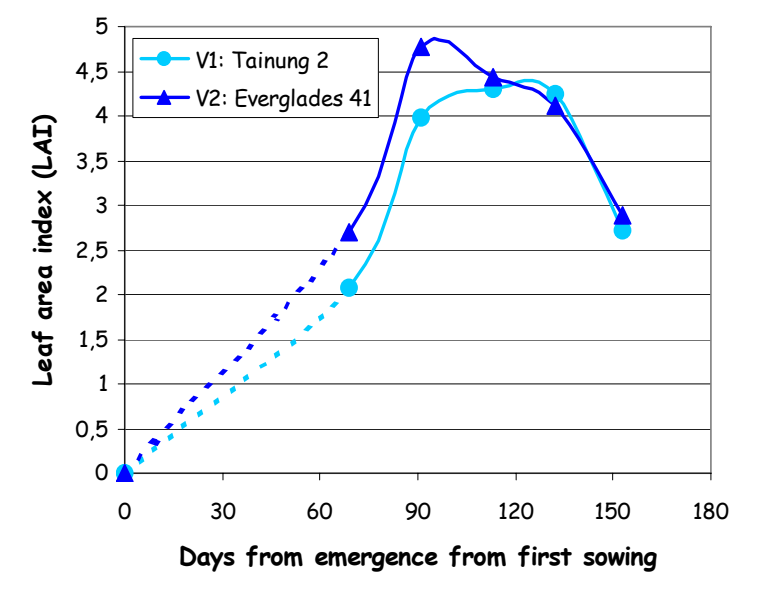


The final stem diameter, averaged overall factors, was 18.5 mm, while in 2003 was a little higher and was 19.1 mm.

Evolution of leaf area meter (LAI) during 2004

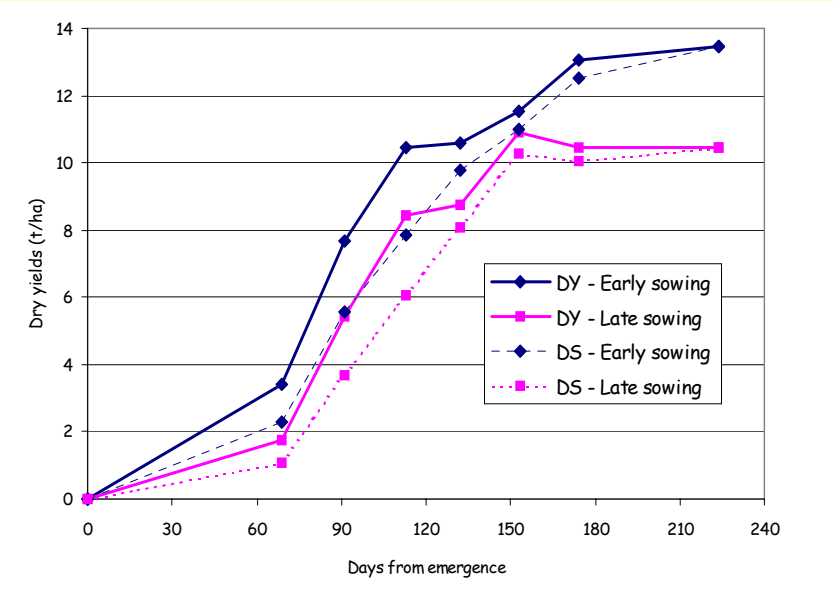


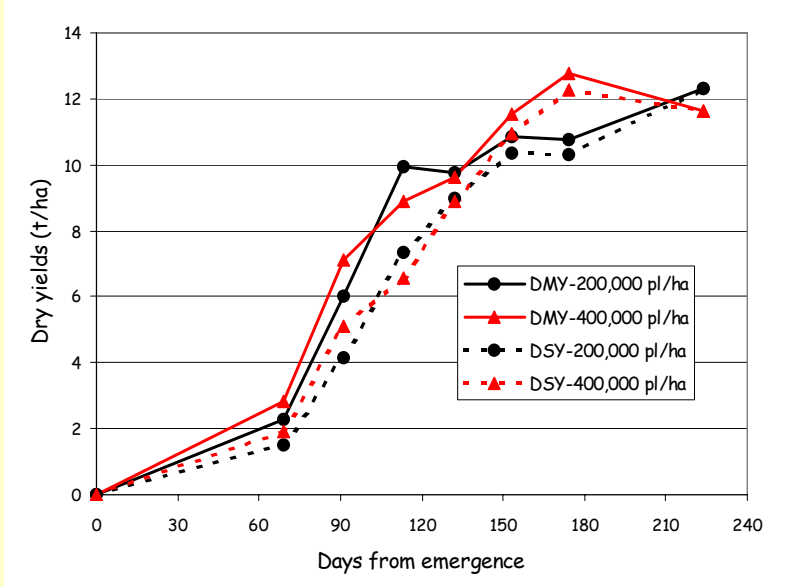


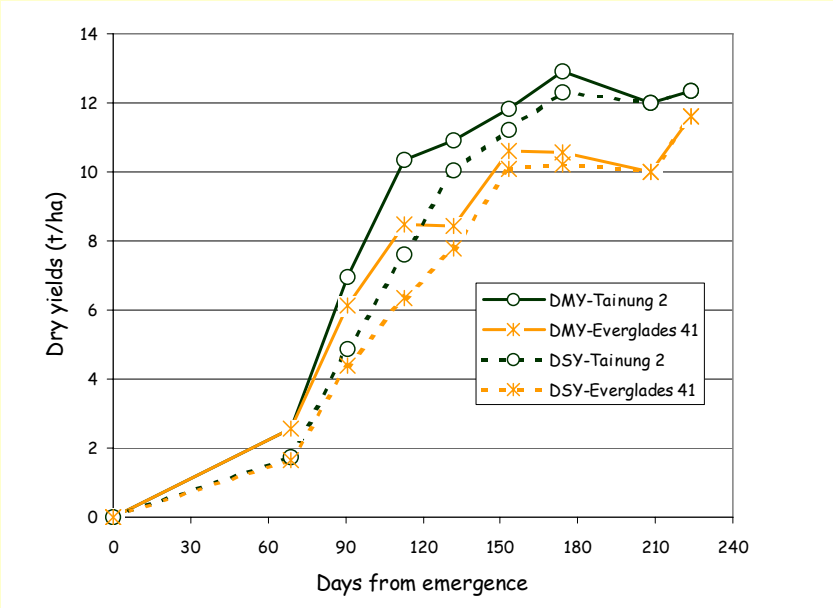


The mean pick LAI values were recorded between the end of August and the middle of September (beginning of the flowering phase) and was 4.4, averaged overall treatments.

Accumulation of dry matter yields (t/ha)

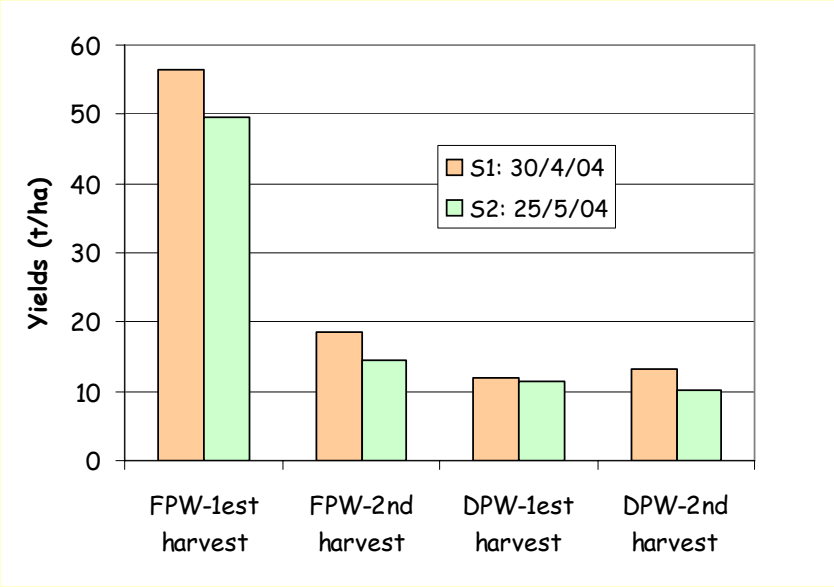


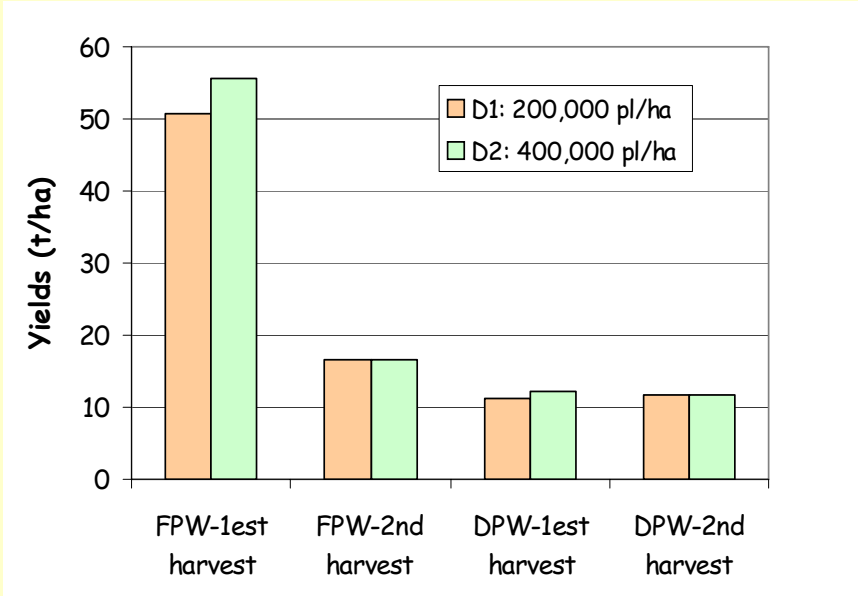


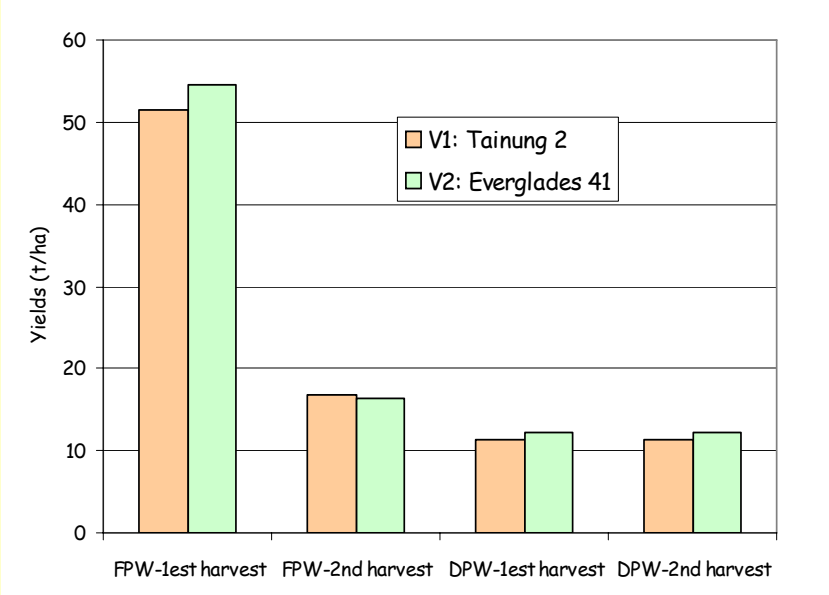


The dry yields, averaged overall treatments, reached high values from the end of October that was 11.8 t/ha and continued to give the same values until the final harvest (December 2004)

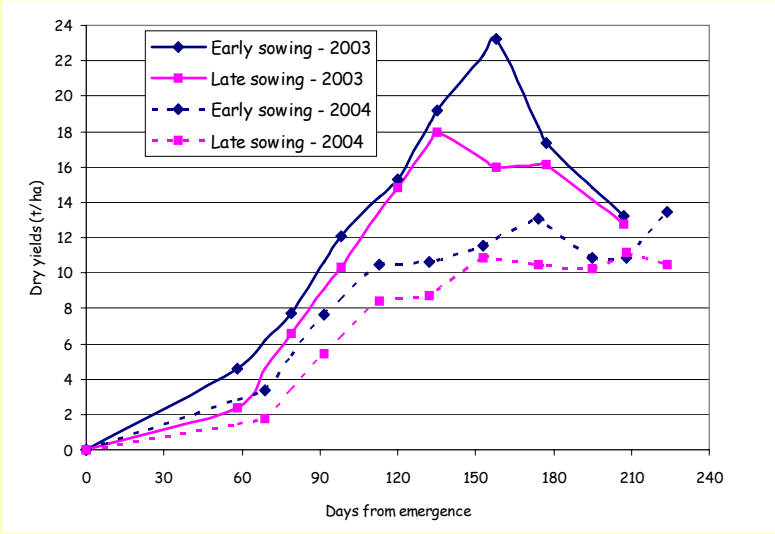
Comparison of dry yields (t/ha) between October and December

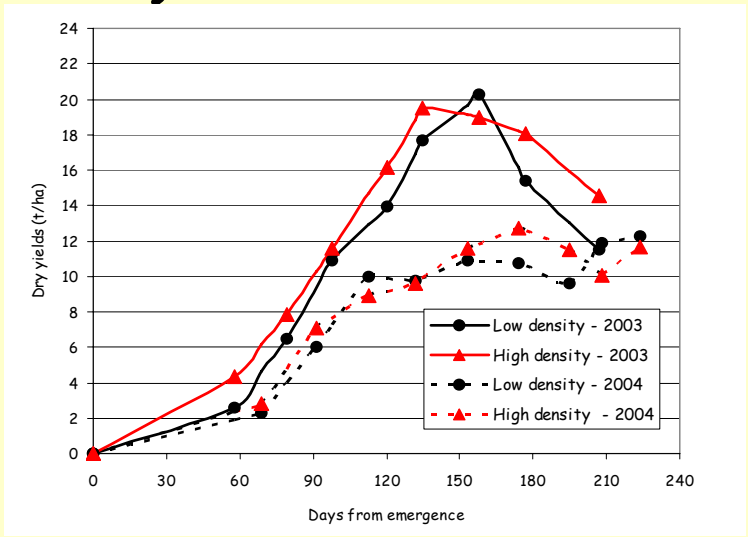


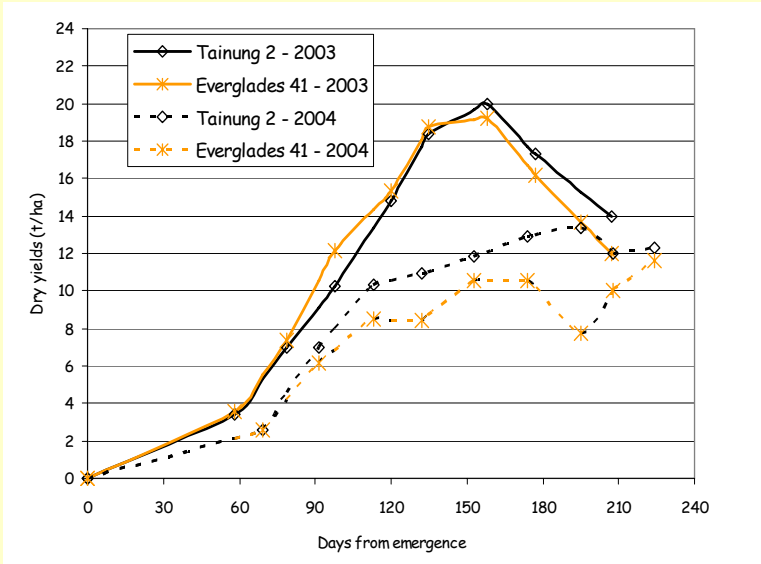




Comparison between 2003 and 2004 yield results for the tested factors (sowing dates, plant densities and varieties)







A comparison between the first and the second year showed that although in 2003 the pick values were higher (middle of October) at the final harvest the achieved yields were almost the same (mean dry yields 13t/ha versus to 12t/ha in 2004).

Conclusions from the sowings trial

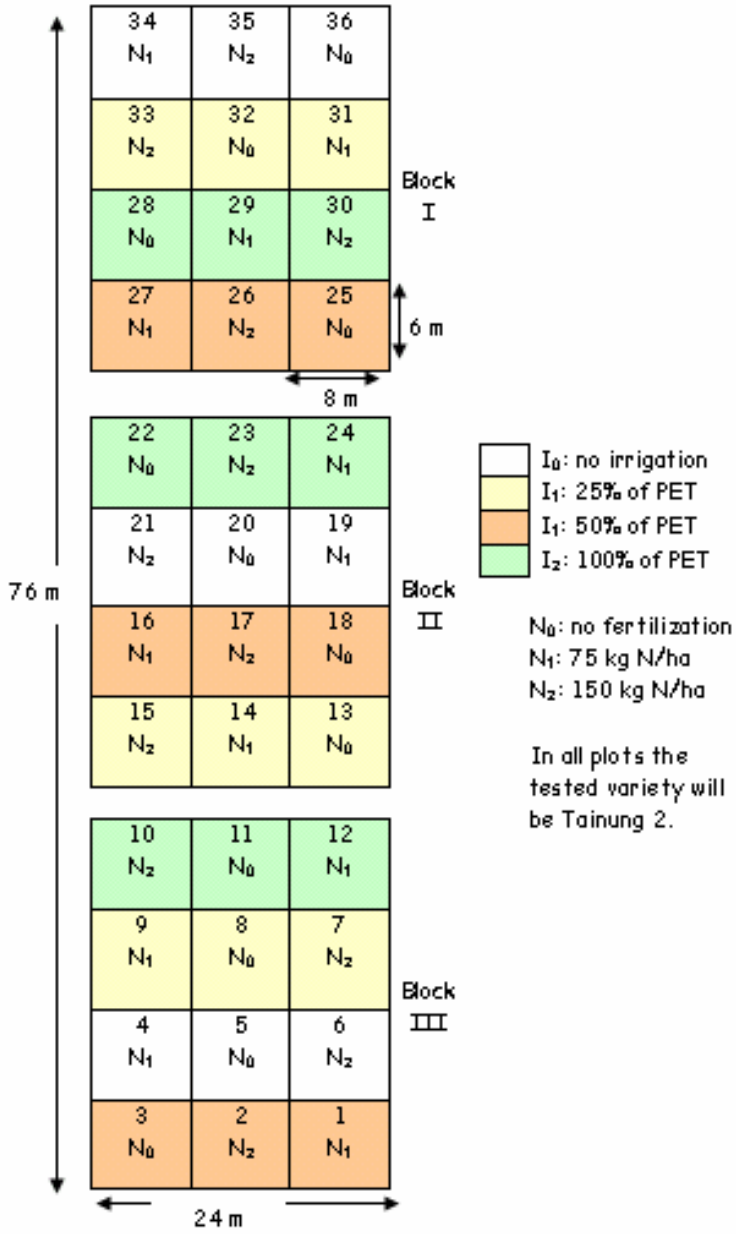
- **Effect of sowing time on yields**
  Statistical significant differences were recorded between the two sowing dates until the end of August 2004 for the tested parameters (plant height, diameter and biomass yields). At the end of the growing season (December 2004) the early sowing results in higher plants (253 cm versus to 215 cm), with smaller stem diameter (18.8 mm versus to 18.1 mm) and with higher dry matter yields (18.7 t/ha versus to 15t/ha).

- **Effect of plant density on yields**
  Until the end of August 2004 the plots with the density of 400,000 pl/ha were more productive compared to the plots of the 200,000 pl/ha (with statistical differences, LSD Test, P<0.05). In the middle of September the dry yields of two plant densities were almost the same 9.7 t/ha (200,000 pl/ha) and 9,6 t/ha (400,000 pl/ha). At the final harvest (December 2004) the highest yields were recorded in the plot with the low density (12.3 versus to 11.6 t/ha).

Conclusions from the sowings trial

- **Effect of variety on yields**
  During the growing period a certain superiority in terms of dry yields was recorded of Tainung 2 over Everglades 41. **So, at the final harvest the productivity of Tainung 2 was came up to 12.3 t/ha, while of Everglades 41 was 11.6 t/ha.** It should be noted that between the two varieties statistical significant differences were recorded only in few cases.

Experimental layout of Task 2.3
Irrigation and nitrogen fertilization rates



Date of sowing: 11/5/04

↓

Date of emergence: 16/5/04

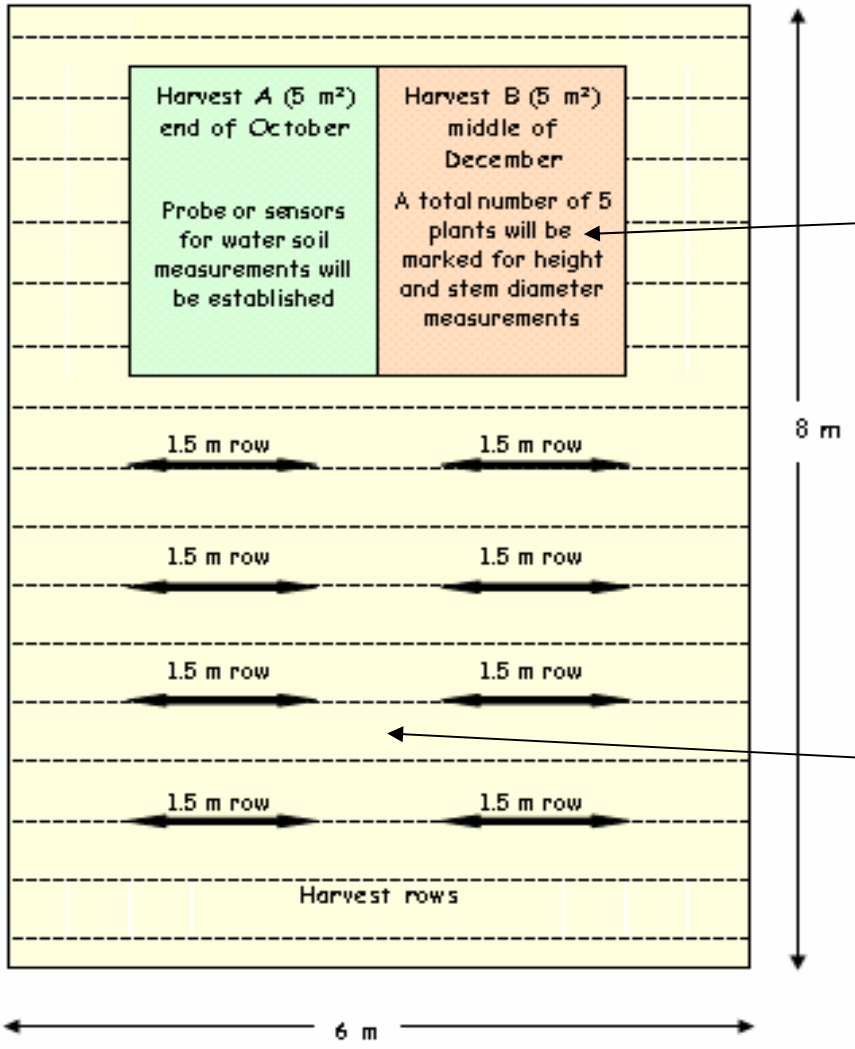
↓

Date of thinning: 8/6/04

↓

The different levels of nitrogen fertilization was applied through the drip irrigation system in the beginning of July 2004

Experimental plot of Task 2.3
Irrigation and nitrogen fertilization rates



- The size of each plot will be 6×8m (48m²)
- The distance between the rows will be 50 cm and within the rows 10 cm (200,000 plants/ha).
- One variety will be sown (Tainung 2 or Everglades 41).
- A total number of 16 rows will be sown in each plot.

The plant height was measured on five marked plant per plot every two weeks, while on the same plants the basal stem diameter was measured every four weeks.

Harvest dates:

12/7/04

3/8/04

25/8/04

13/9/04

4/10/04

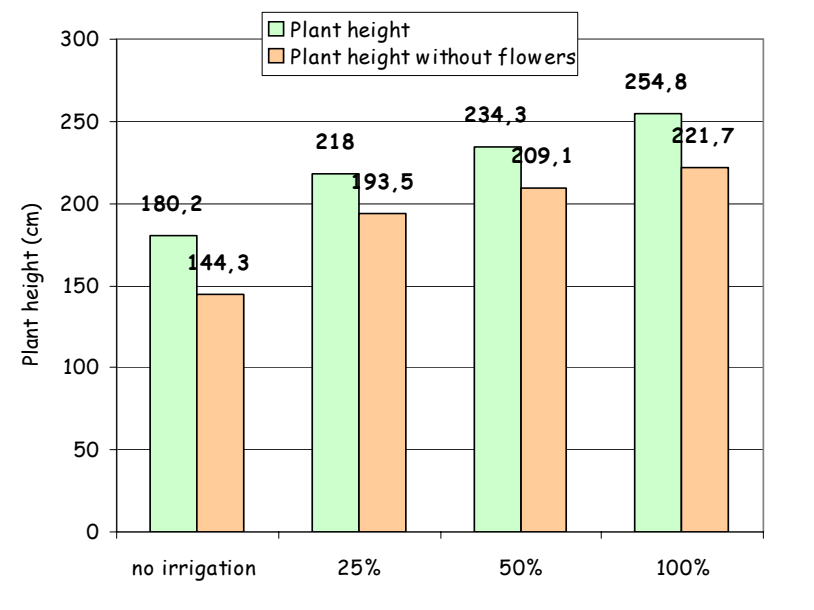
25/10/04

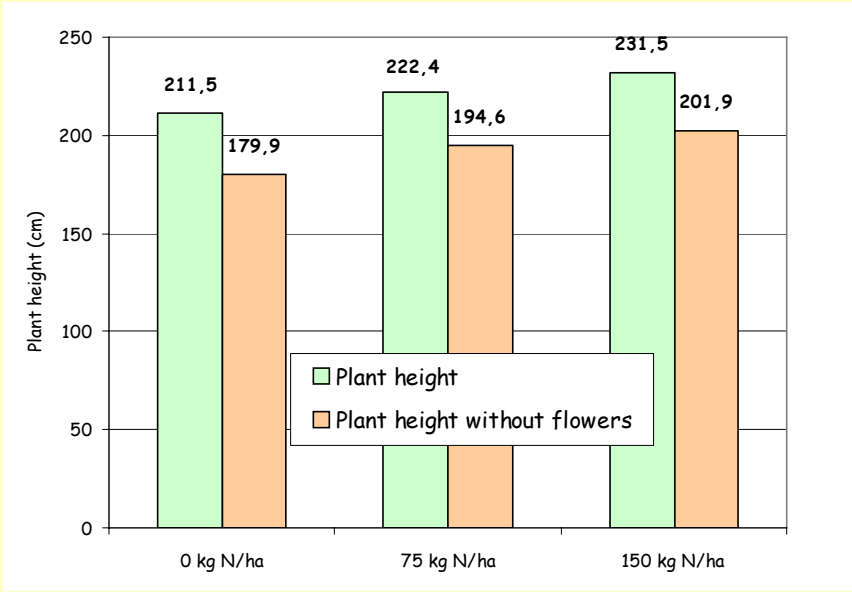
15/11/04

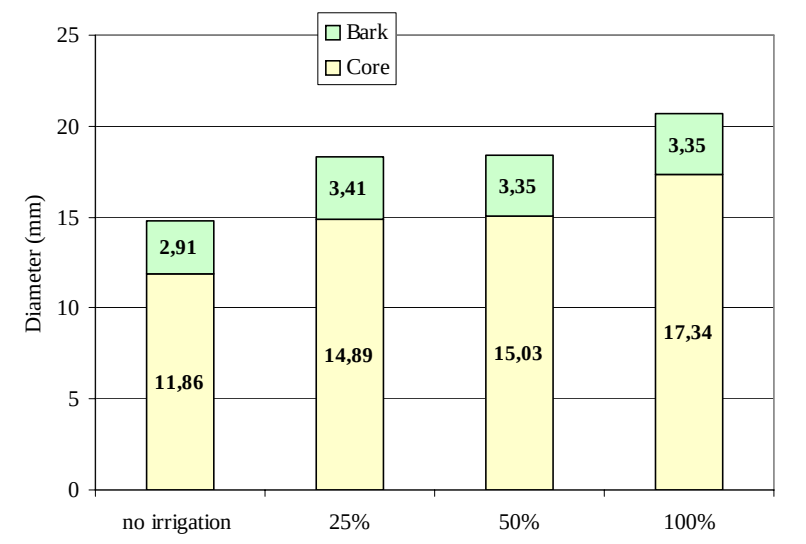
28/11/04

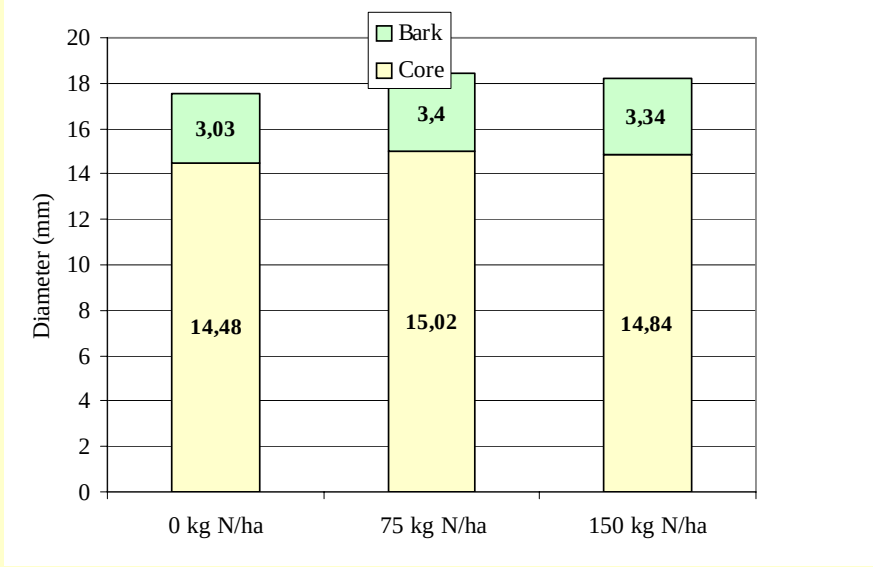
14/12/04

Plant height (cm) and basal stem diameter (mm)

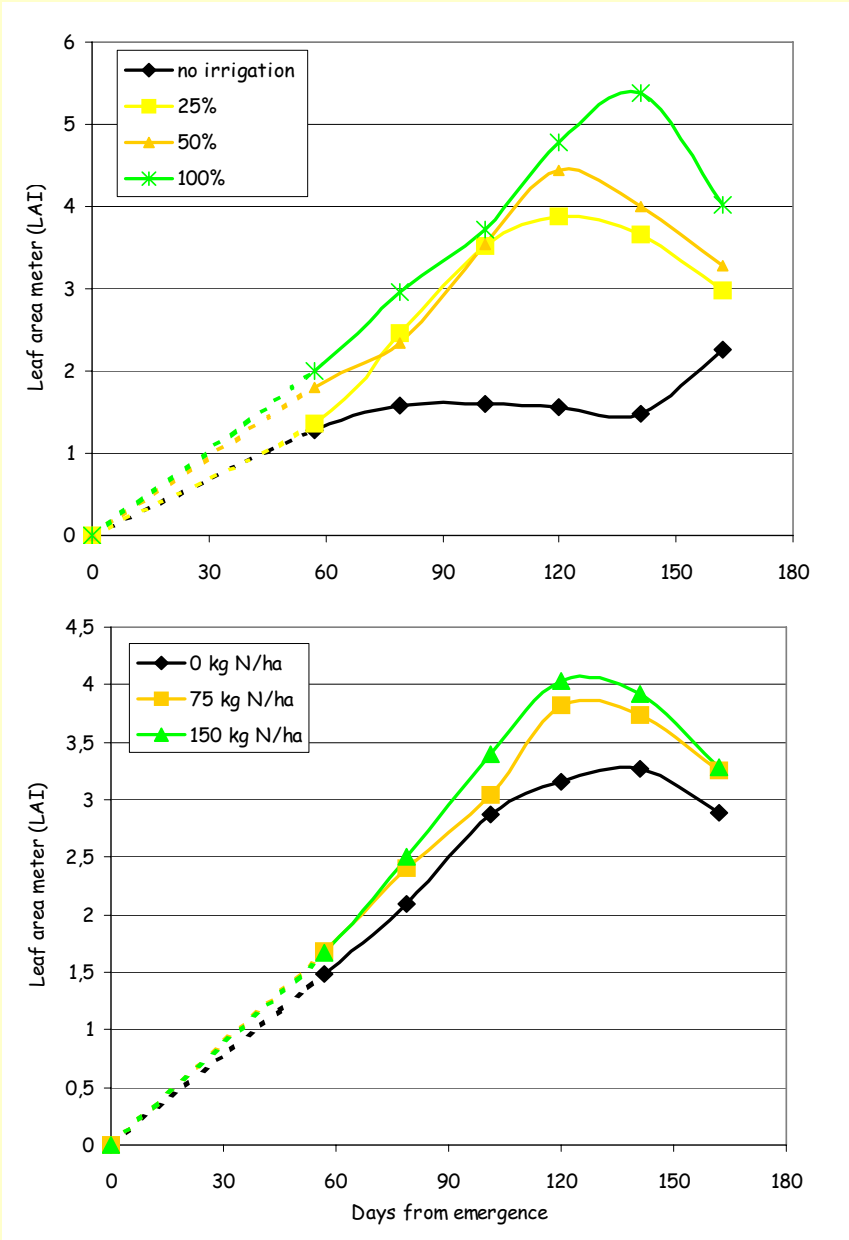






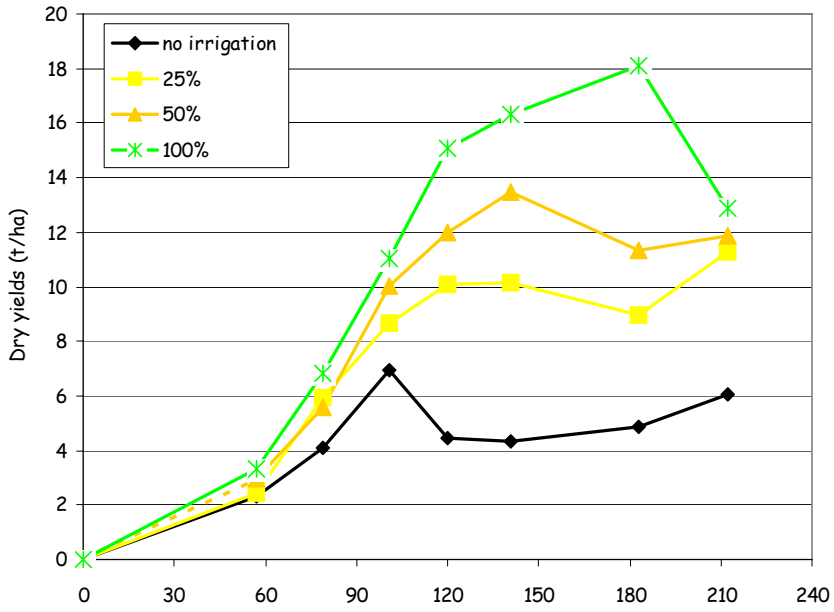


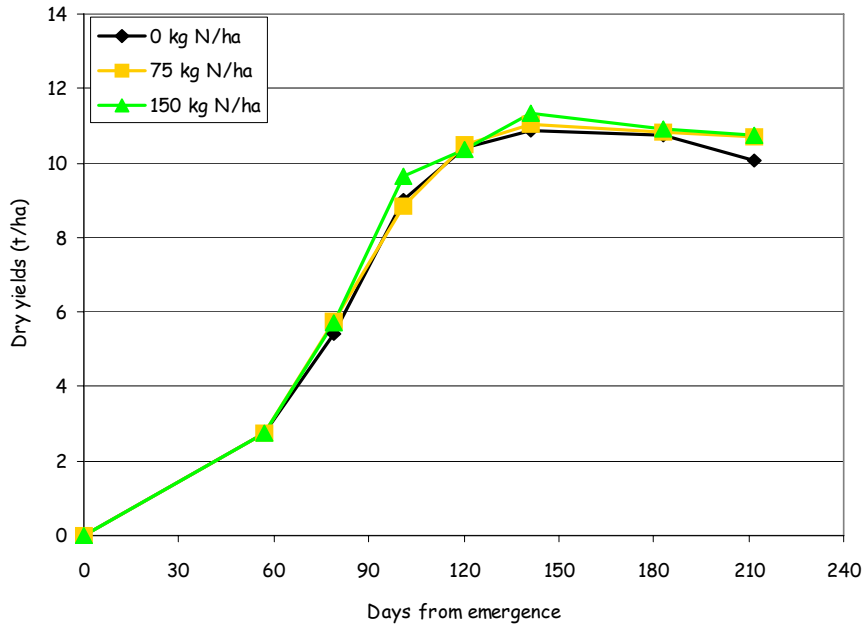
Evolution of leaf area meter (LAI) in 2004



- The pick leaf area values for all treatments were recorded from middle of September to early October and were **2.3 for the no-irrigated plants, 3.9 for the low irrigated, 4.4 for the medium irrigated and 5.4 for the high irrigated ones.**
- It should be pointed out that statistical significant differences were recorded **only among the different irrigation rates.**
- The pick values for the three tested nitrogen rates were **almost the same and ranged between 3.2 (no fertilization) and 4 (150 kg N/ha)**

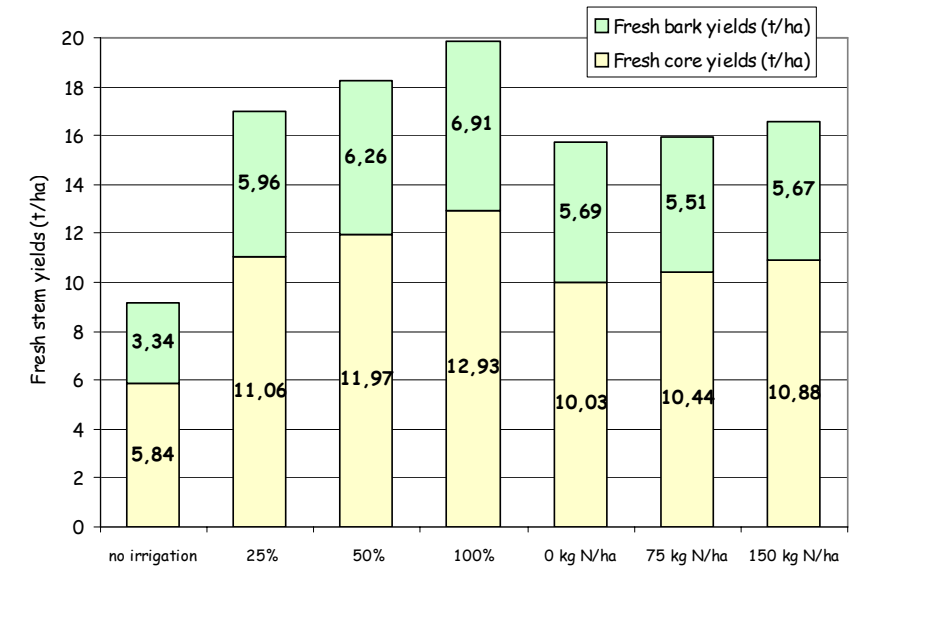
Accumulation of dry matter yields (t/ha) in 2004

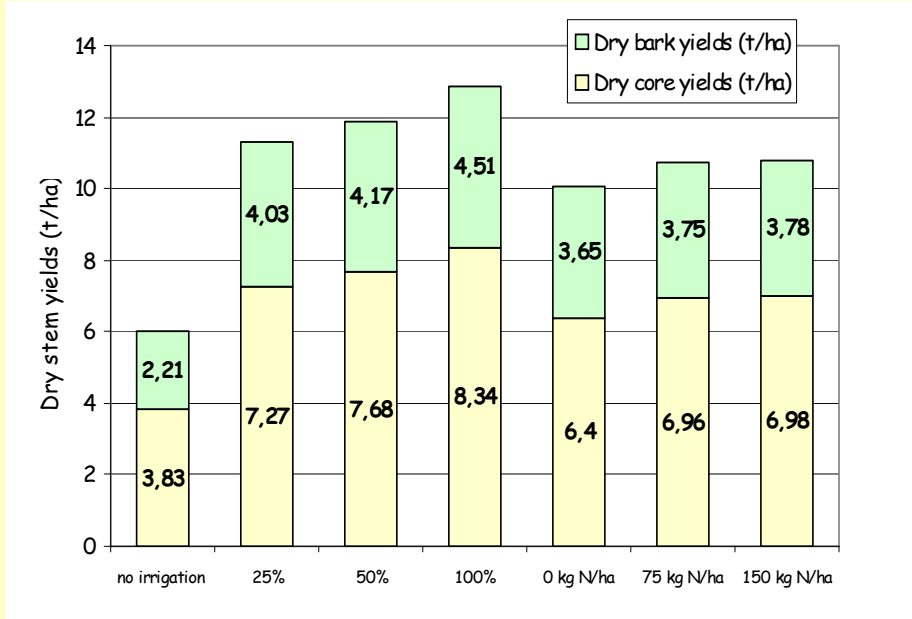




- At the final harvest (December 2004) the achieved dry yields were 6 t/ha (no irrigation), 11.3 t/ha (low irrigation), 11.9 t/ha (medium irrigation) and 12.9 t/ha (high irrigation). It should be pointed out that statistical significant differences were throughout the growing period among the tested irrigation rates.
- The dry yields among the tested nitrogen rates were almost the same throughout the growing period and so no statistical differences were recorded. At the final harvest the dry yields were 10t/ha (no fertilization), 10.7 t/ha (75 kg N/ha) and 10.8 t/ha (150 kg N/ha).

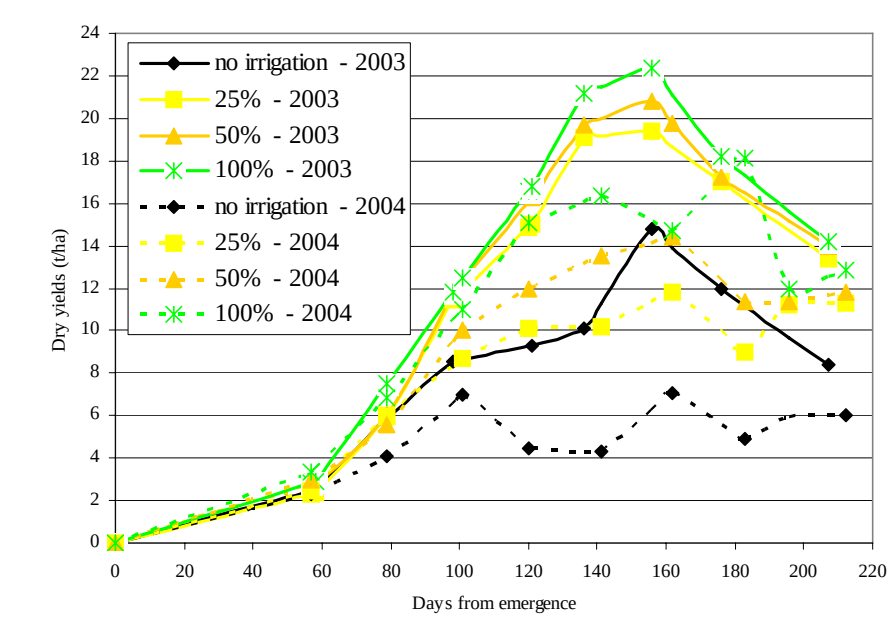
Stem yields (bark and core) on fresh and dry basis at the final harvest (14/12/04)

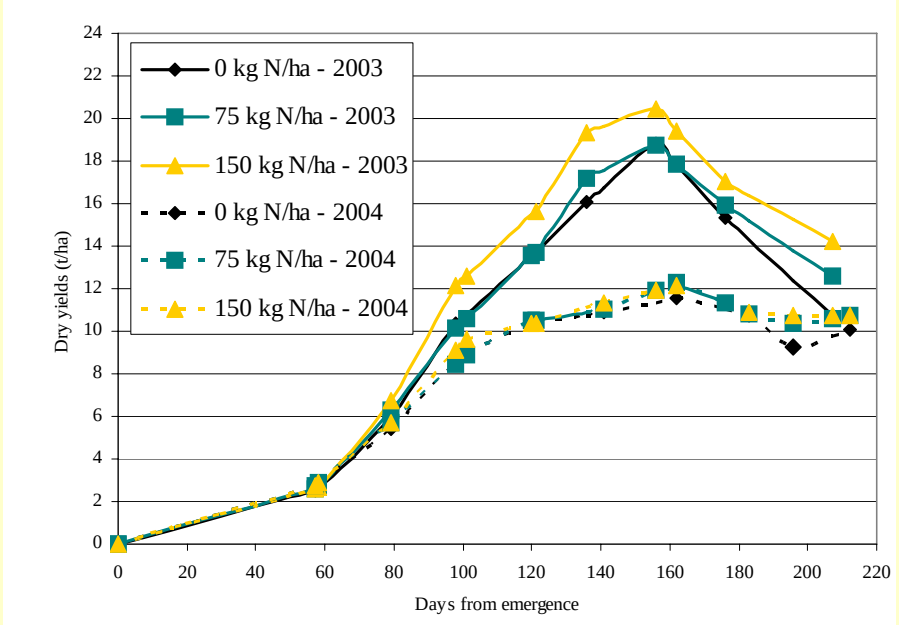




- The bark percentage (% on dry basis), averaged overall treatments, was 35%.
- It worth mentioning that at the no irrigated plots and at the no fertilized plots the bark percentage was a littlie bit higher 36% compared to the irrigated and well fertilized plots that the bark percentage was between 34 and 35%.

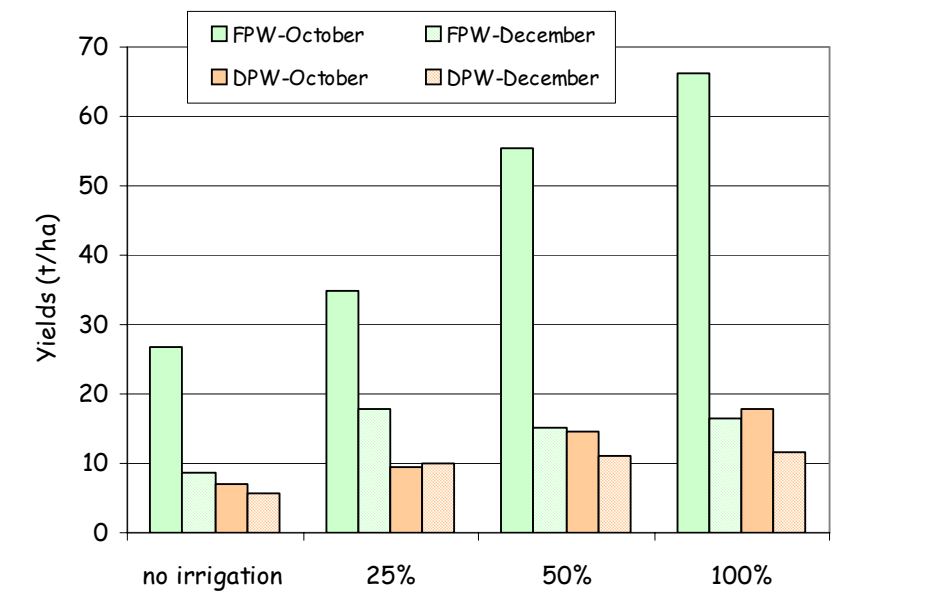
Comparison (2003-2004) of the dry yields (t/ha) for the under study factors (irrigation and fertilization)

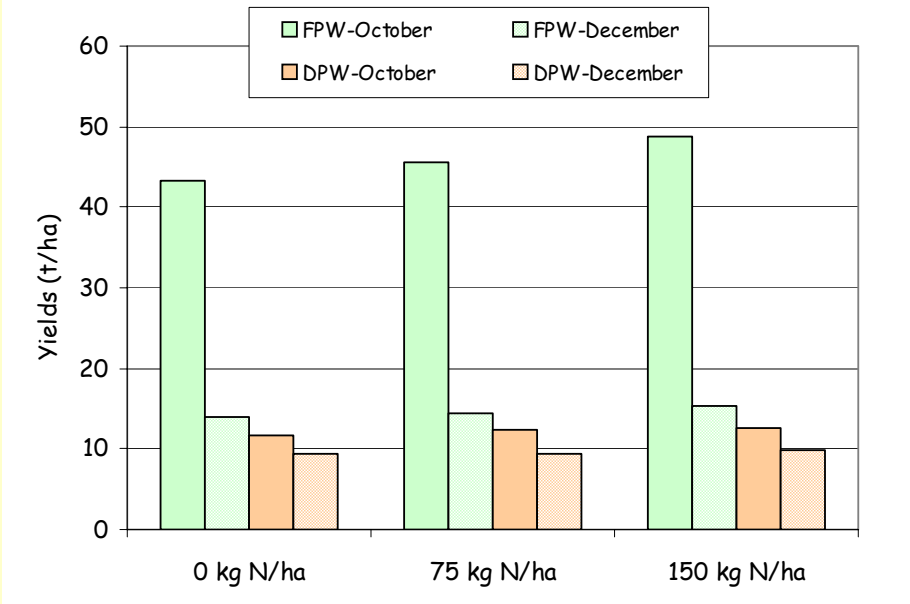




- Higher yields for all the under study factors were recorded in 2003 compared to 2004 results. The reduction of dry yields in 2004 compared to 2003 values came up 19%.
- In both years the dry yields among the tested irrigation rates differ statistically, while among the tested nitrogen rates no differences were recorded.

Dry yields (t/ha) for the under study factors (irrigation, nitrogen) in the two big harvest of 5m² (October – December)





The reduction of dry yields between October and December came up to 24%. It should be noted that in October the plants had a moisture content of 74 % averaged overall treatments, while in December was only 34%.

Conclusions from the irrigation trial

- **Irrigation effect on yields**
  Statistical significant differences were recorded for all the measured parameters concerning **the four irrigation rates (LSD Test, P<0.05)**. At the final harvest (14/12/04) the achieved yields were 6 t/ha on the no-irrigated plots, 11.3 t/ha on the plots with the low irrigation, 11.9 t/ha on the medium irrigated and 12.9 t/ha on the high irrigated plots.
- **Nitrogen effect on yields**
  On the other hand **no statistical significant were recorded among the three tested nitrogen fertilization rates** and the achieved yields at the final harvest (December 2004) were almost the same 10.1 t/ha (0 kg N/ha), 10.7 t/ha (75 kg N/ha) and 10.8 t/ha (150 kg N/ha)