WP2
Adaptability and Productivity Field Trials

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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

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Task 2.2 – Effect of different sowing dates and plant populations on biomass yields

2 sowing dates x 2 varieties x 2 plant densities x 3 replicates

S_1: 27/6/2003
S_2: 11/7/2003

V_1: Tainung 2
V_2: Everglades 41

D_1: 20 plants/m^2
D_2: 40 plants/m^2

Each field: 8 x 5 m^2

75 kg N/ha
120 kg K_2O/ha
60 kg P_2O_5/ha

Task 2.3 – Effect of irrigation and nitrogen fertilization on biomass yields

4 irrigation levels x 3 nitrogen fertilization x 3 replicates

I_1: 0% PET= 204 mm H2O
I_2: 25% PET = 253 mm H2O
I_3: 50% PET = 301 mm H2O
I_4: 100% PET = 400 mm H2O

At early stages of growth, all the fields were fully irrigated in order to compensate the water deficit of the soil
41 days after sowing, irrigation was differentiated

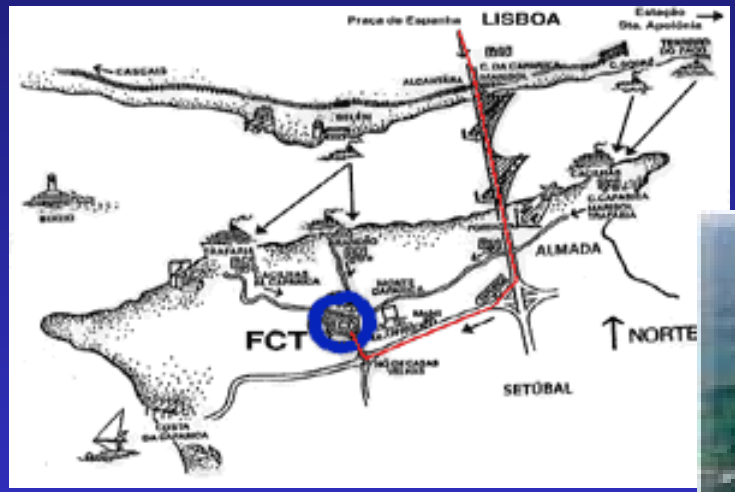
N_1: 0 kg N/ha
N_2: 75 kg N/ha
N_3: 150 kg N/ha

Variety: Tainung 2
Sowing: 4/7/2003
20 plants/m^2

Each field: 9 x 5 m^2
120 kg K_2O/ha
60 kg P_2O_5/ha

Experimental fields

Located in Monte de Caparica, in the Peninsula of Setúbal, near the University - near Lisbon, in the south border of river Tejo

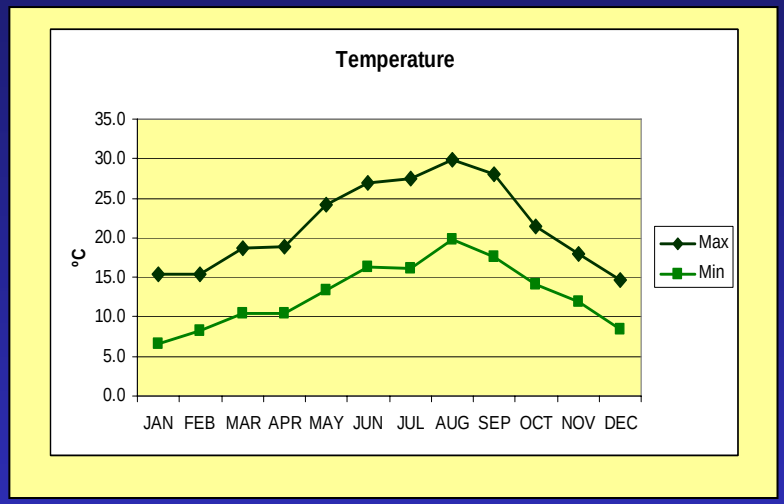


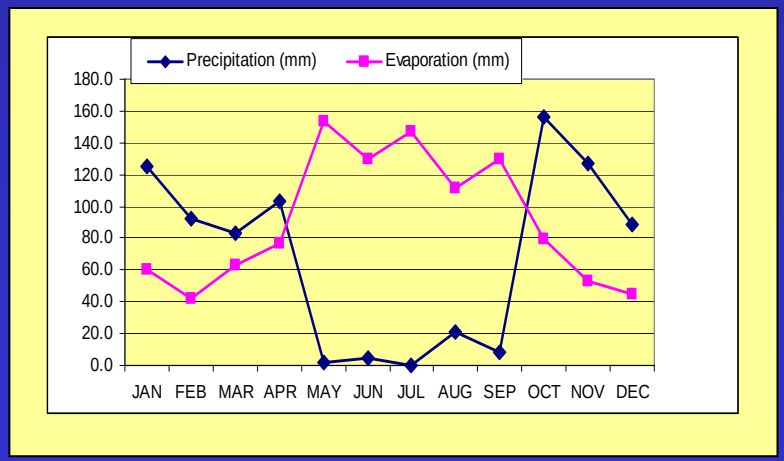
Fields

Latitude: 38º 40´ N
Longitude: 9º W
Altitude: 50 m

Urban area near the Atlantic coast and the estuarine zone

Climatic conditions at Monte de Caparica in 2003





During the experimental period

average minimum temperature - 15.6ºC
average maximum temperature - 23.0ºC

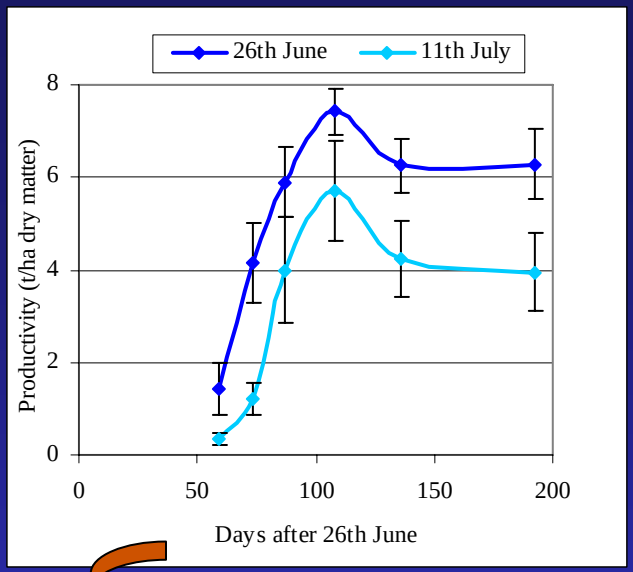
440 mm rainfall

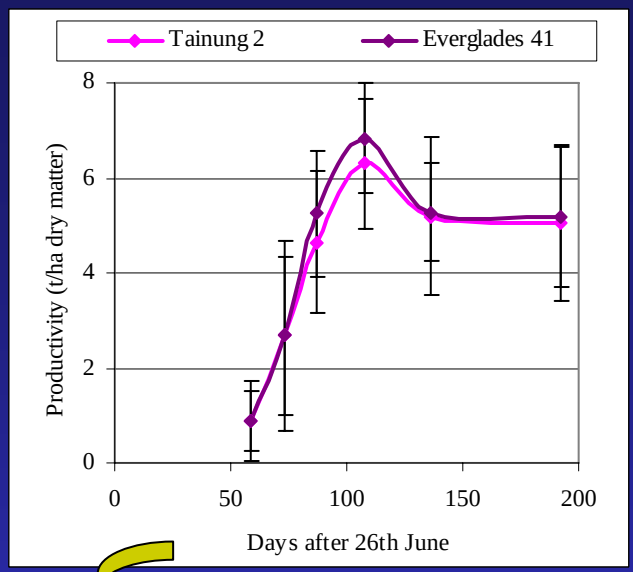
Irrigation is necessary between May and September

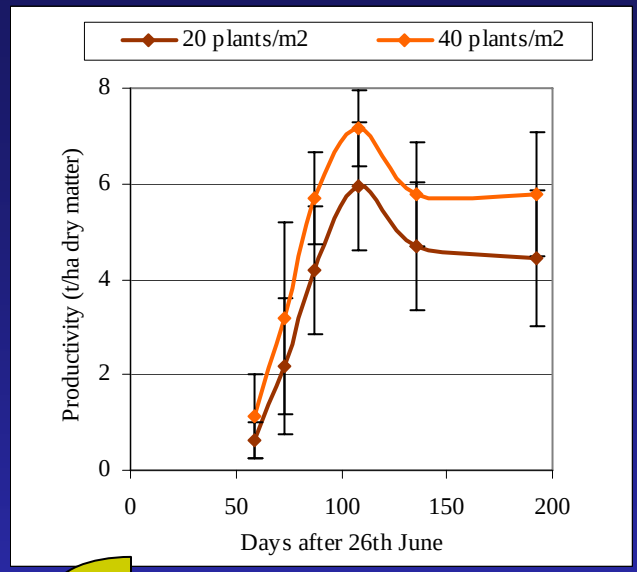
Task 2.2

– Effect of different sowing dates and plant populations on biomass yields

Biomass Productivity







Significative differences between S1 and S2

S1 > S2

No differences between V1 and V2

No differences between D1 and D2

Biomass Productivity

highest productivities,
obtained 108 days after sowing (October 2003)
After this date, the productivities lowered mainly due to the loss of the leaves

Bark 34-40%

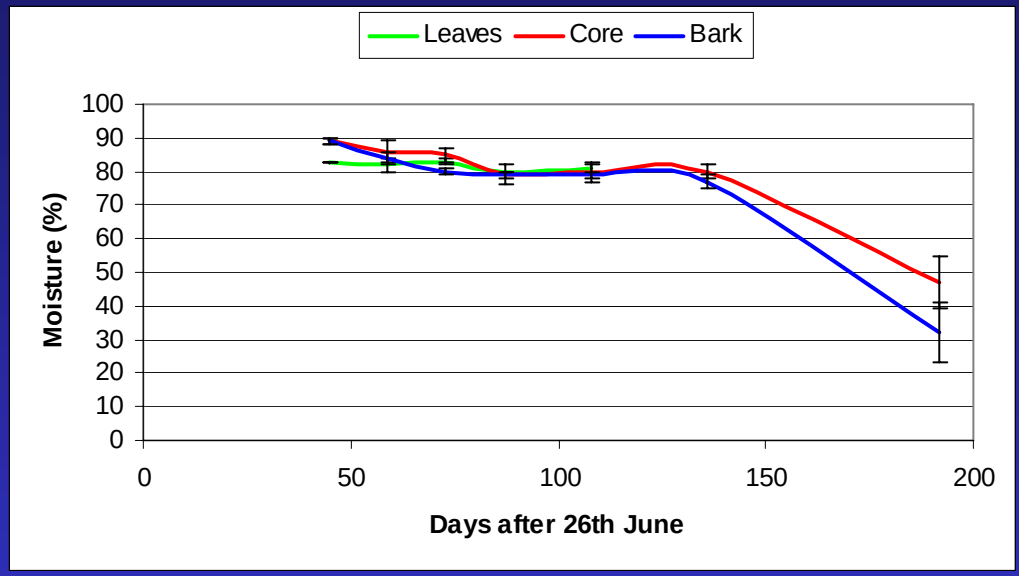
Core 60-66%

Productivities obtained
lower than those obtained by other mediterranean partners of the Biokenaf project

Mainly due to the difficulties experienced during the first year of the project,
namely,
the late sowing date
the heat wave that occurred during the 2003 Summer

Biomass Quality

Moisture content



Moisture content decreased along the growing season

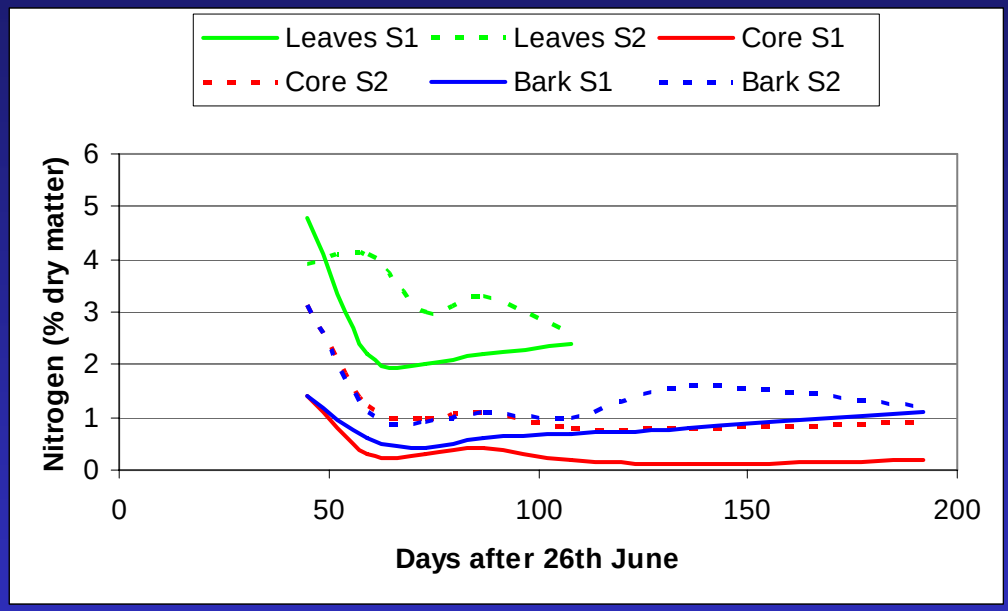
less at 192 days after sowing

At this date, bark presented less moisture than core material

No significative differences among all the fields

Biomass Quality

Nitrogen content



Nitrogen content decreased along the growing season

Higher in leaves than in stems

Higher in bark than in core

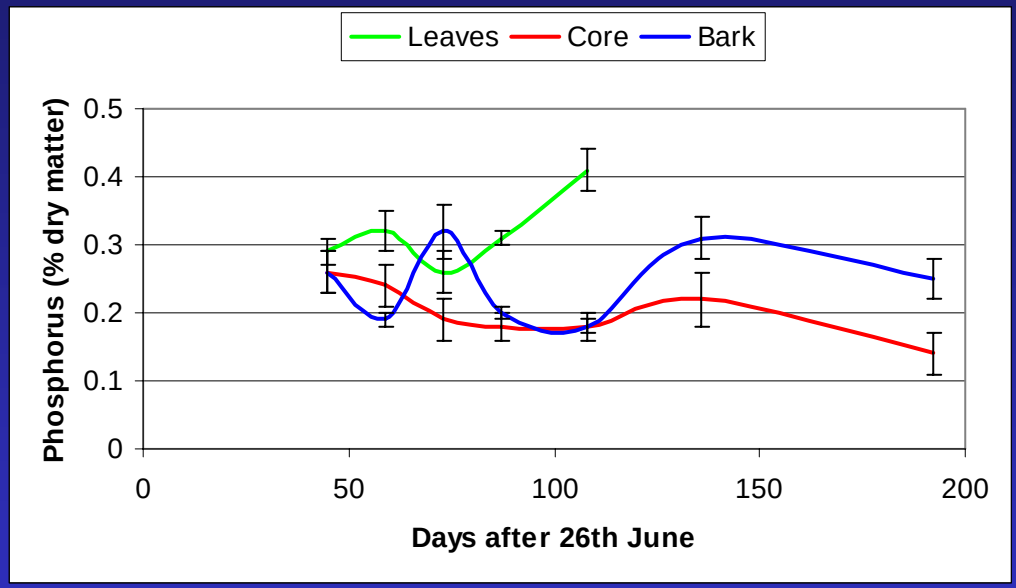
No significative differences between varieties and plant populations

Significative differences between sowing dates

N (S1) < N (S2)

Biomass Quality

Phosphorus content



Phosphorus content in core decreased along the growing season

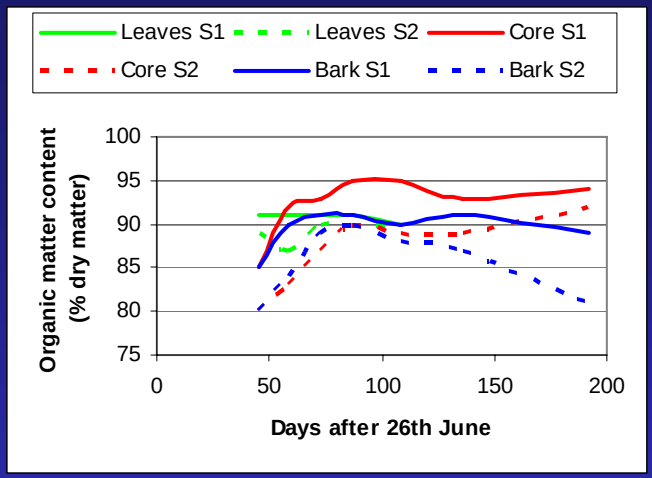
Higher in leaves than in stems

Higher in bark than in core

No significative differences among all the fields

Biomass Fuel Quality

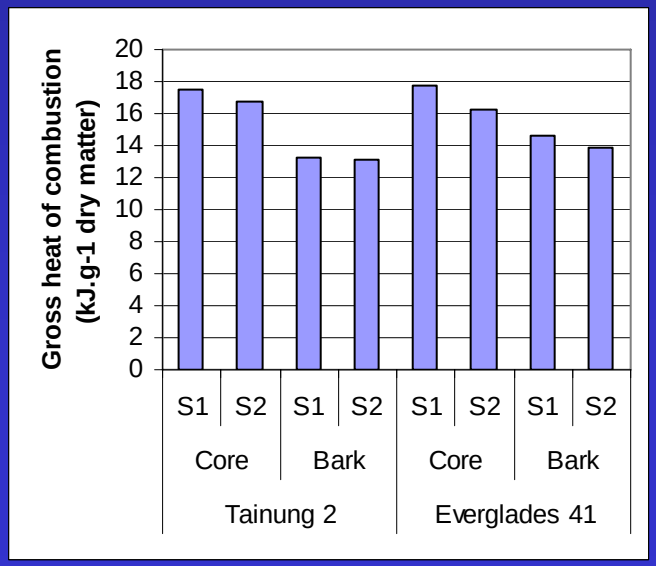
Organic matter content



Better quality for energy purposes at the end of the growing season when the ash content was lower

No differences between varieties

Gross Heat of Combustion



Bark presents an inferior quality for energy purposes than core

S1 better than S2 for energy purposes

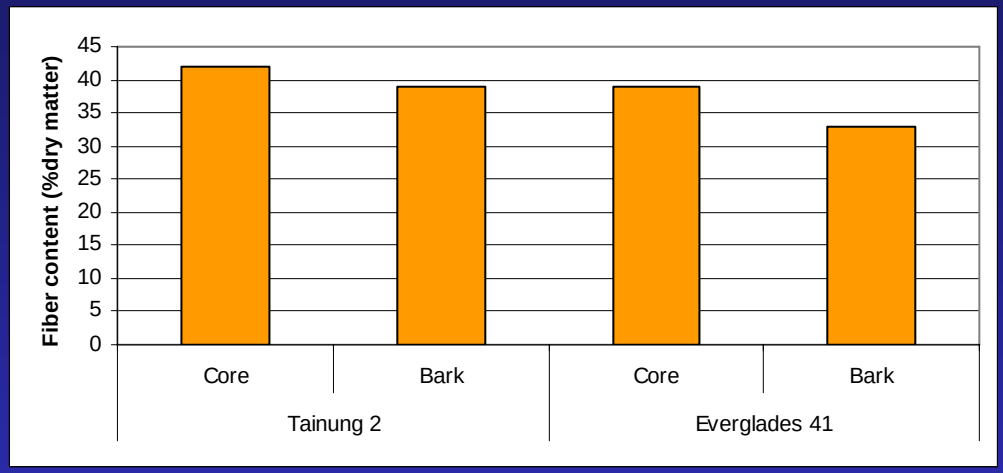
No differences between plant populations

Bark Everglades 41 > Bark Tainung 2

Core Everglades 41 = Core Tainung 2

Biomass for Pulp production

Fiber content



No differences between
sowing dates
plant populations

Bark Tainung 2
>
Bark Everglades 41

Core Everglades 41
=
Core Tainung 2

No differences between fiber content of bark and core
Bark contains less lignin and more cellulose than core

Harvest Date

Strong effects on the biomass productivity and biomass quality

the crop should only be harvested after 108 days after sowing, when all the leaves have already fallen – November onwards

Productivity was higher 136 days after sowing than 192 days after sowing, but this difference was not significant

In terms of the kenaf biomass quality,

the composition of the biomass changed over the course of the growth period as nitrogen, phosphorus and water content decreased and organic matter increased

The lowest values for the moisture content and for the minerals contents were registered 192 days after sowing (early January), but differences, for nitrogen and phosphorus, were not significant in relation to the results obtained 136 days after sowing

But due to the lowest value of moisture at 192 days,

early January should be the harvest date chosen in the climatic conditions of Monte de Caparica, near Lisbon, Portugal

Conclusions

Productivity

Biomass Quality

affected by the Sowing date

S1 better than S2

not by the Plant population

Tainung 2

Everglades 41

Similar productivities and mineral composition
Core - same quality for energy and pulp purposes
Bark - Everglades 41 more energy than Tainung 2
Tainung 2 more fiber than Everglades 41

Conclusions

Date of Harvest

Affected the Productivity Biomass Quality

Early November: better yields, although not significantly different to the early January yields

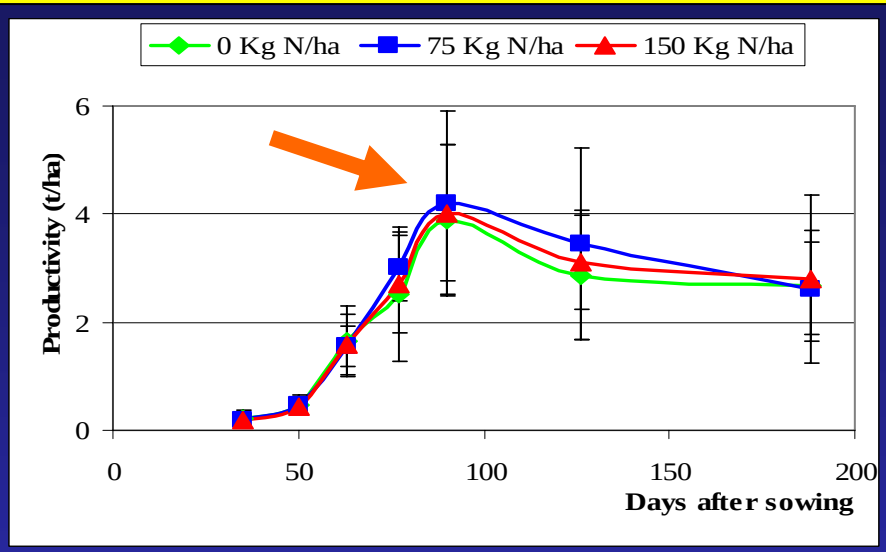
Early January: biomass with better quality

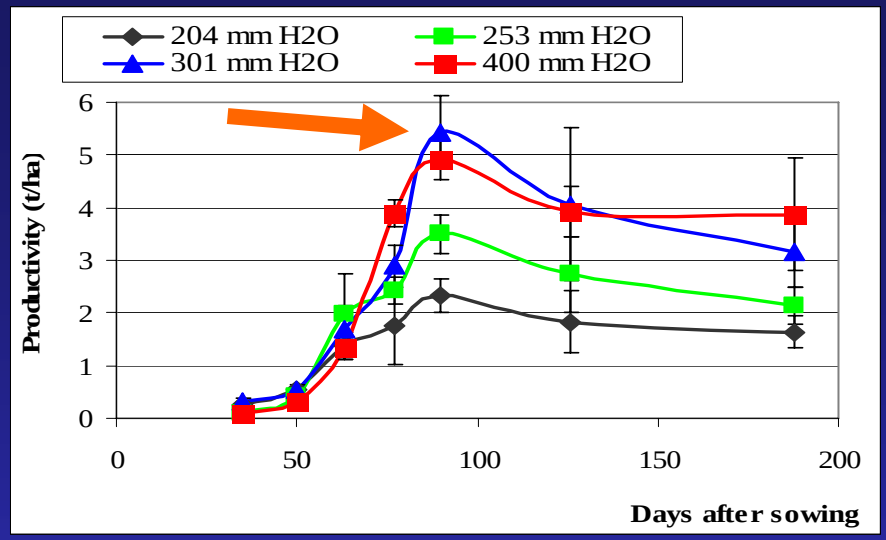
Regarding the requirements of the energy and pulp production industries, the early January harvest date should be the one chosen

Task 2.3

– Effect of irrigation and nitrogen fertilization on biomass yields

Biomass Productivity





No significant differences with different levels of nitrogen,

probably because the soil was rich in nitrogen

Significative differences with different levels of irrigation

Higher productivities:

50% and 100% PET fields

Biomass Productivity

highest productivities,
obtained 90 days after sowing (October 2003)
After this date, the productivities lowered mainly due to the loss of the leaves

Bark 38-40%

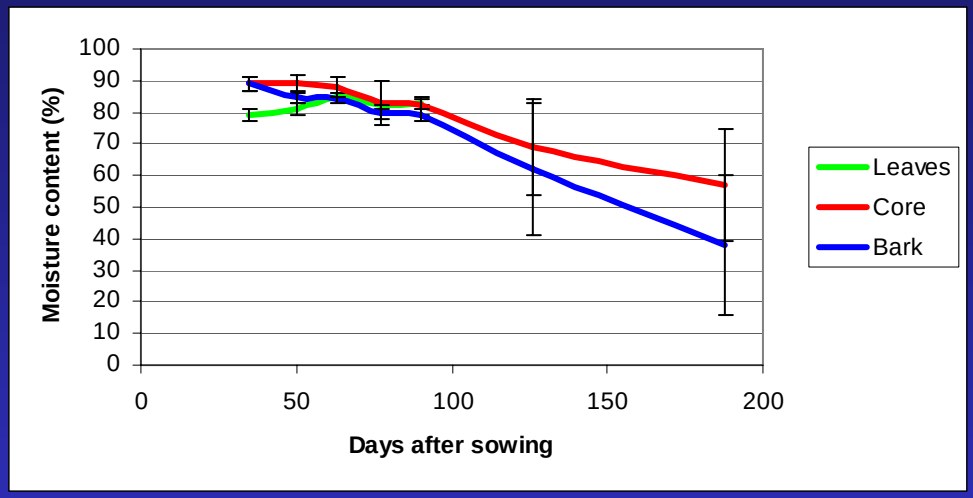
Core 60-62%

Productivities obtained
lower than those obtained by other mediterranean partners of the Biokenaf project

Mainly due to the difficulties experienced during the first year of the project,
namely,
the late sowing date
the heat wave that occurred during the 2003 Summer

Biomass Quality

Moisture content



Moisture content
decreased along the growing season

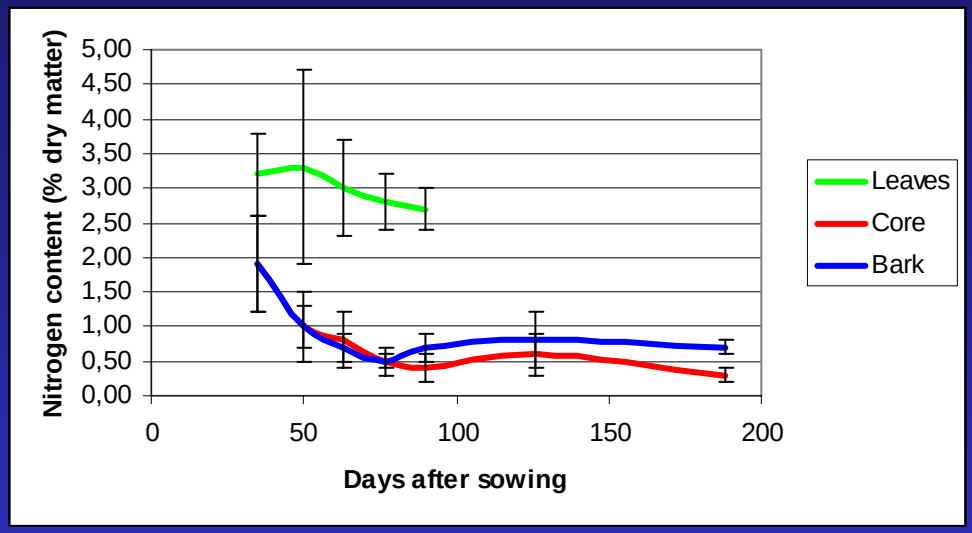
less at 188 days after sowing

At this date,
bark presented less moisture than core material

No significative differences among
different levels of nitrogen
different levels of irrigation

Biomass Quality

Nitrogen content



Nitrogen content decreased along the growing season

Higher in leaves than in stems

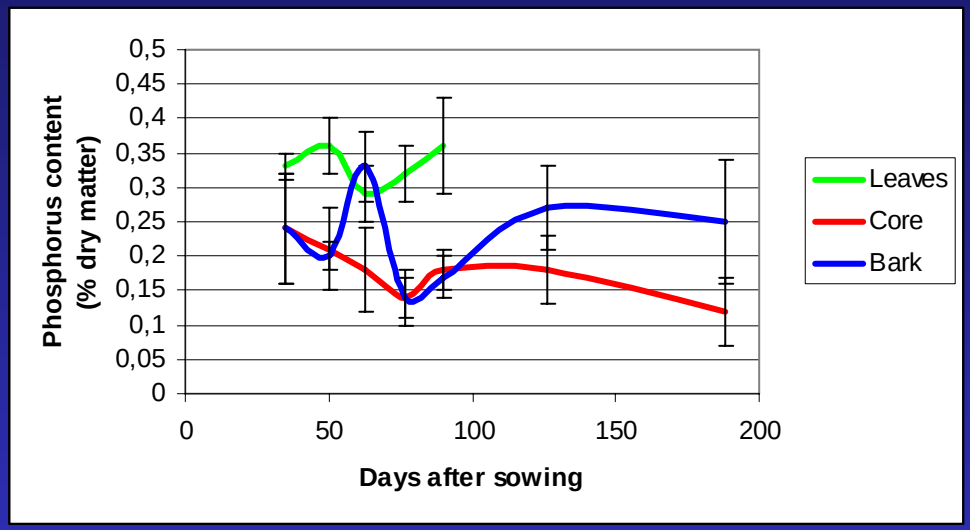
Higher in bark than in core

No significative differences among

different levels of nitrogen
different levels of irrigation

Biomass Quality

Phosphorus content



Phosphorus content in core decreased along the growing season

Higher in leaves than in stems

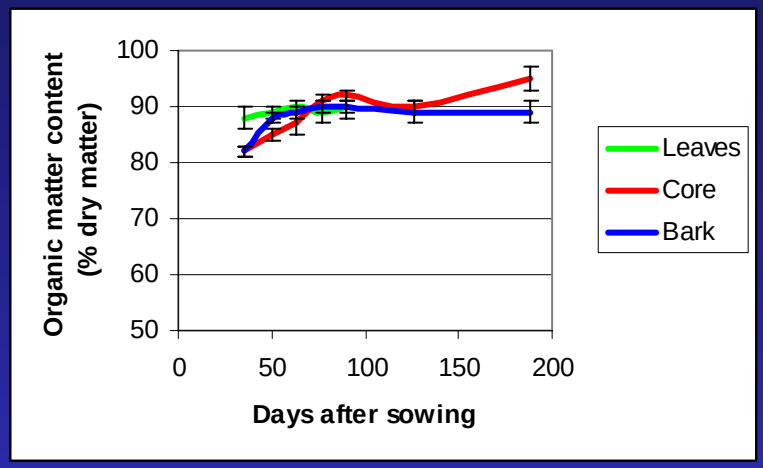
Higher in bark than in core

No significative differences among

different levels of nitrogen
different levels of irrigation

Biomass Fuel Quality

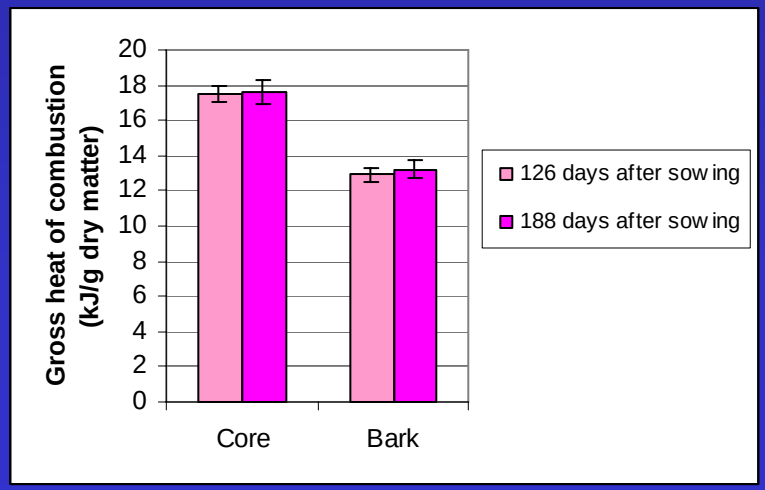
Organic matter content



Better quality for energy purposes at the end of the growing season when the ash content was lower, specially in core

Bark presents an inferior quality for energy purposes than core

Gross Heat of Combustion

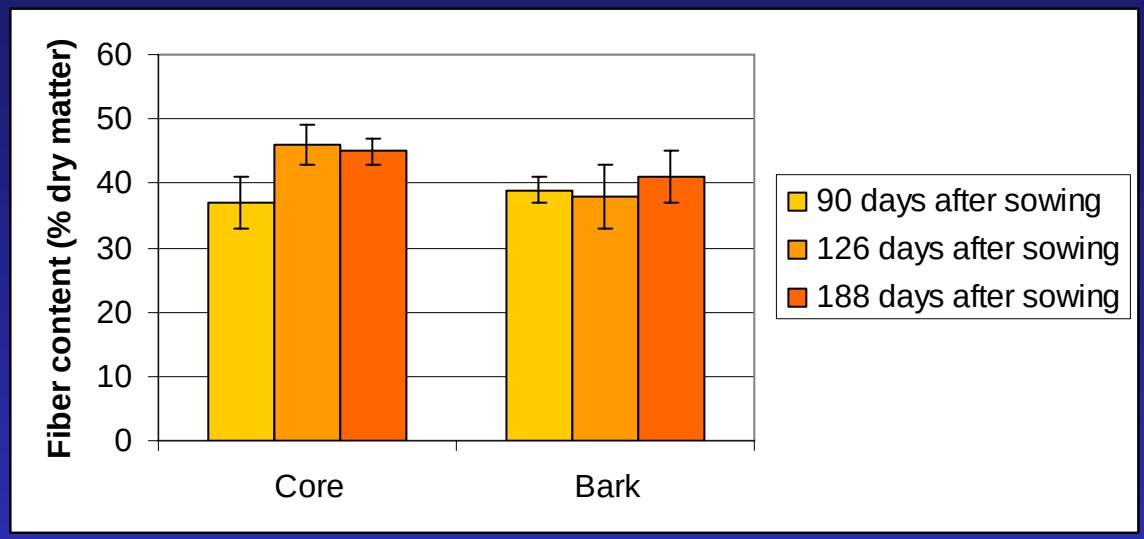


No differences among
levels of nitrogen
levels of irrigation

No differences between 126 and 188 days after sowing

Biomass for Pulp production

Fiber content



No differences among
levels of nitrogen
levels of irrigation

No differences between fiber content of bark and core
Bark presents a superior quality for pulp production than core

No differences among 90, 126 and 188 days after sowing

Harvest Date

Strong effects on the biomass productivity and biomass quality

the crop should only be harvested after 90 days after sowing, when all the leaves have already fallen – November onwards

Productivity was higher 126 days after sowing than 188 days after sowing, but this difference was not significant

In terms of the kenaf biomass quality,

the composition of the biomass changed over the course of the growth period as nitrogen, phosphorus and water content decreased and organic matter increased

The lowest values for the moisture content and for the minerals contents were registered 188 days after sowing (early January), but differences, for nitrogen and phosphorus, were not significant in relation to the results obtained 126 days after sowing

But due to the lowest value of moisture at 188 days, early January should be the harvest date chosen in the climatic conditions of Monte de Caparica, near Lisbon, Portugal

Conclusions

Productivity

affected by the level of irrigation

301 mm (50% PET); 400 mm H_20 (100% PET) better yields

not by the level of N-fertilizer

Biomass Quality

not affected by the level of irrigation and by the level of N-fertilizer

Conclusions

Date of Harvest

Affected the Productivity Biomass Quality

Early November: better yields, although not significantly different to the early January yields

Early January: biomass with better quality

Regarding the requirements of the energy and pulp production industries, the early January harvest date should be the one chosen