

**University of Thessaly**

Department of Agriculture, Crop Production &  
Agricultural Environment

Laboratory of Agronomy and Applied Crop Physiology  
(UTH) Greece

**BioKenaF:**

**A crop growth simulation model for kenaf**

September “27-30” 2006

Madrid, Spain

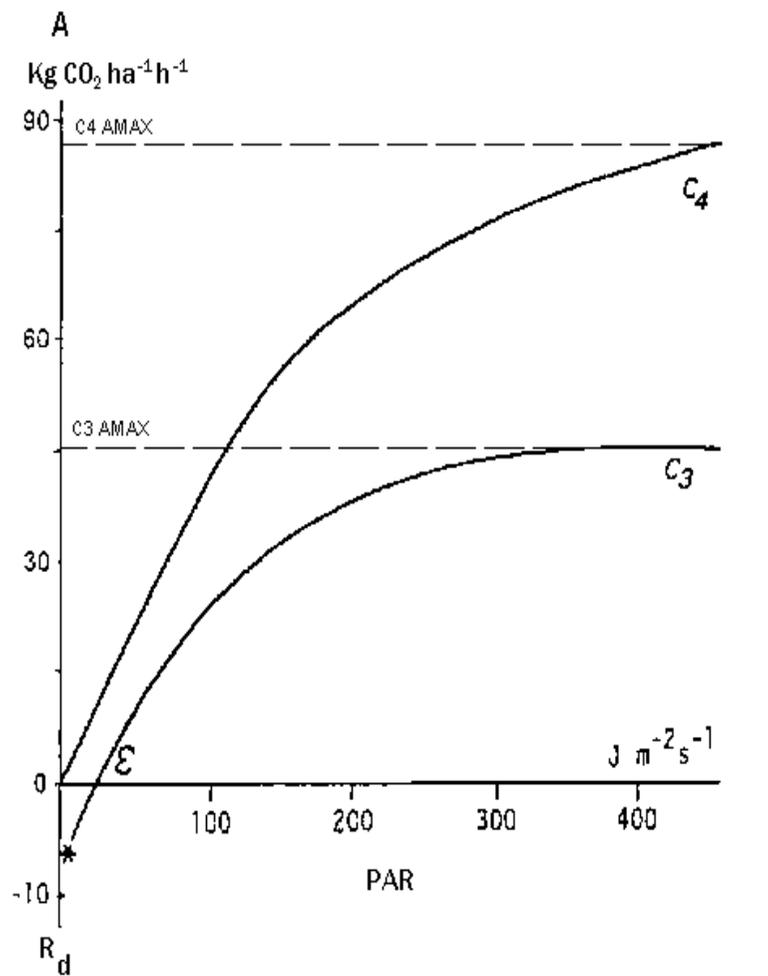
“A Crop Growth Dynamic Simulation Model for Kenaf”

# Model structure

- Leaf Photosynthesis
- Canopy Photosynthesis
- Respiration
- Dry Matter distribution
- Water balance routine



# Leaf Photosynthesis



The relation between available radiation and CO<sub>2</sub> gross assimilation by a single leaf is described by an asymptotic exponential relation

$$FG = AMAX * ( 1 - EXP(- EFF*PAR/AMAX) )$$

FG: assimilation in kg(CO<sub>2</sub>)ha<sup>-1</sup>(leaf)h<sup>-1</sup>

PAR: photosynthetically active radiation(J m<sup>-2</sup>s<sup>-1</sup>)

EFF: is the light use efficiency in kg ha<sup>-1</sup>h<sup>-1</sup>/J m<sup>-2</sup>s<sup>-1</sup>

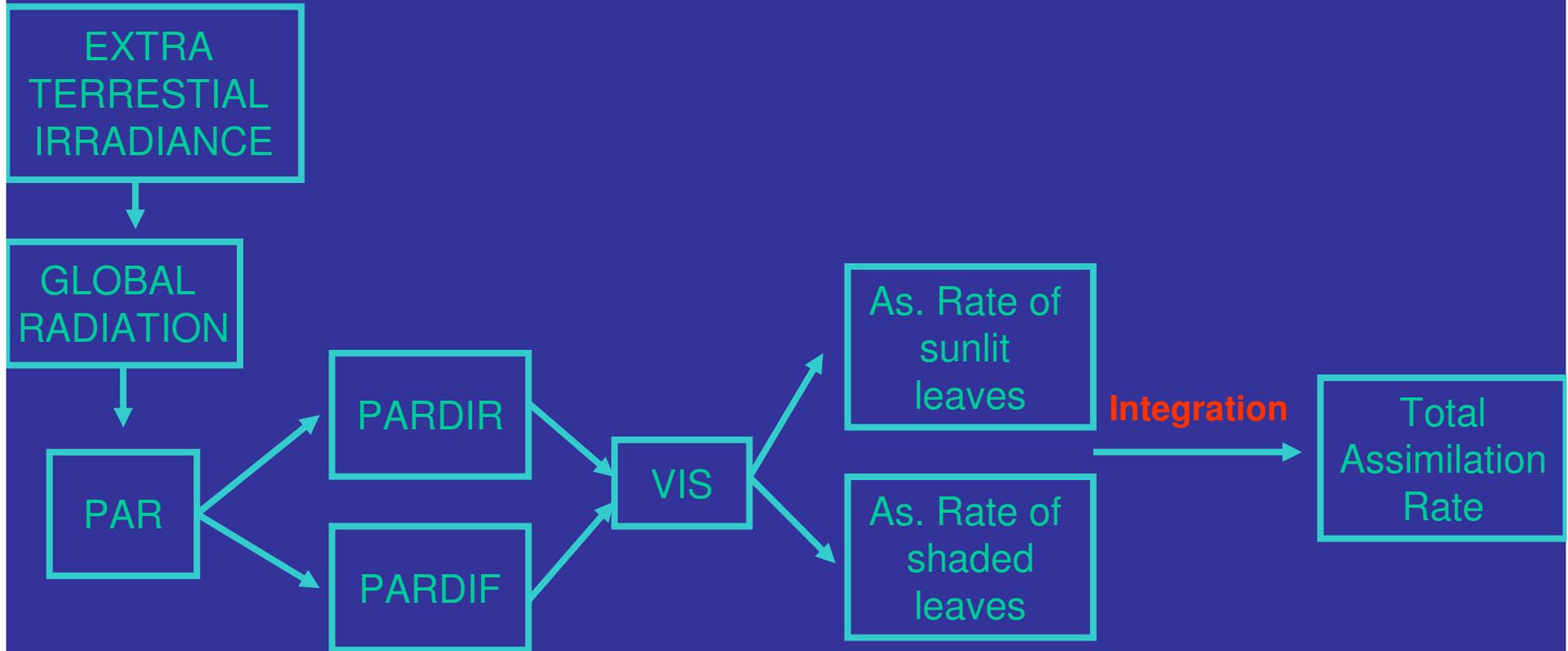
AMAX: maximum rate of CO<sub>2</sub> assimilation in kg(CO<sub>2</sub>)ha<sup>-1</sup>(leaf)h<sup>-1</sup>.



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# Canopy Photosynthesis



# Respiration

**Maintenance respiration (MRR):** Energy consumed to meet maintenance requirements.

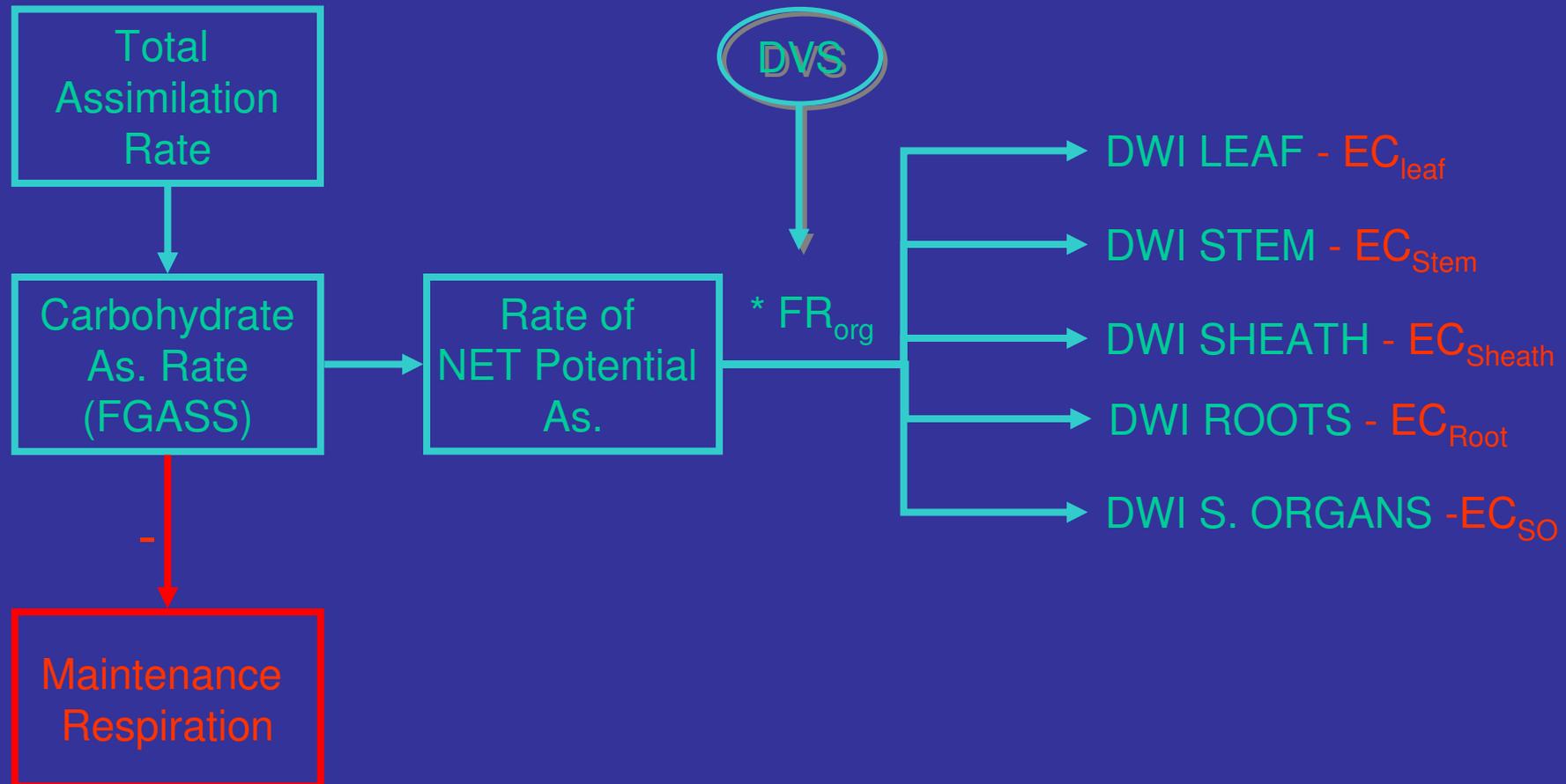
$$MRR_{org} = R_{org} * S_{org}$$

**Growth respiration (EC):** Respiration providing energy for the conversion of primary photosynthesis into structural plant materials like, proteins, cellulose, fats, lignin.

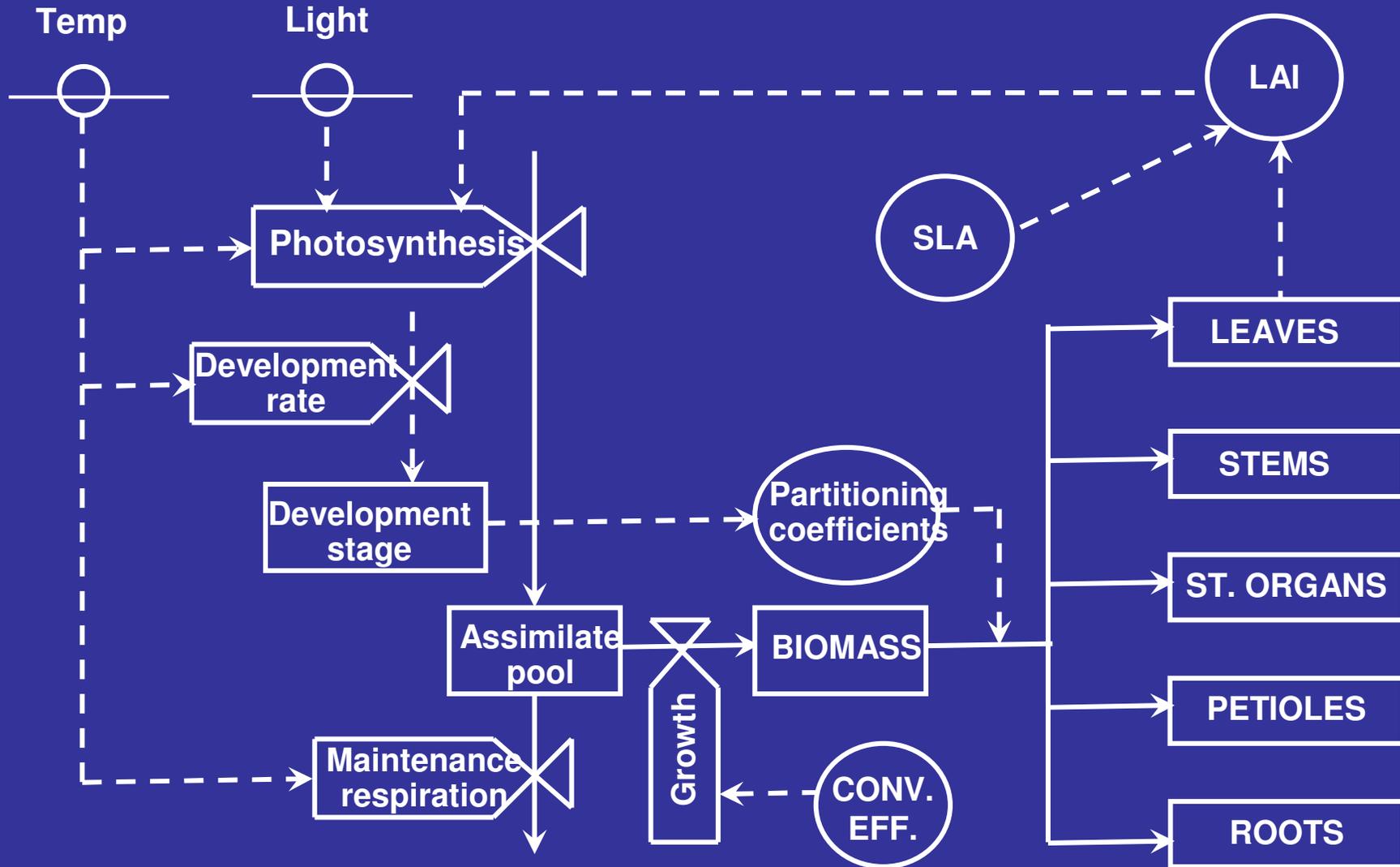
$$DWI_{org} = \text{DailyGain}_{org} * EC$$



# Dry matter distribution (Daily basis)



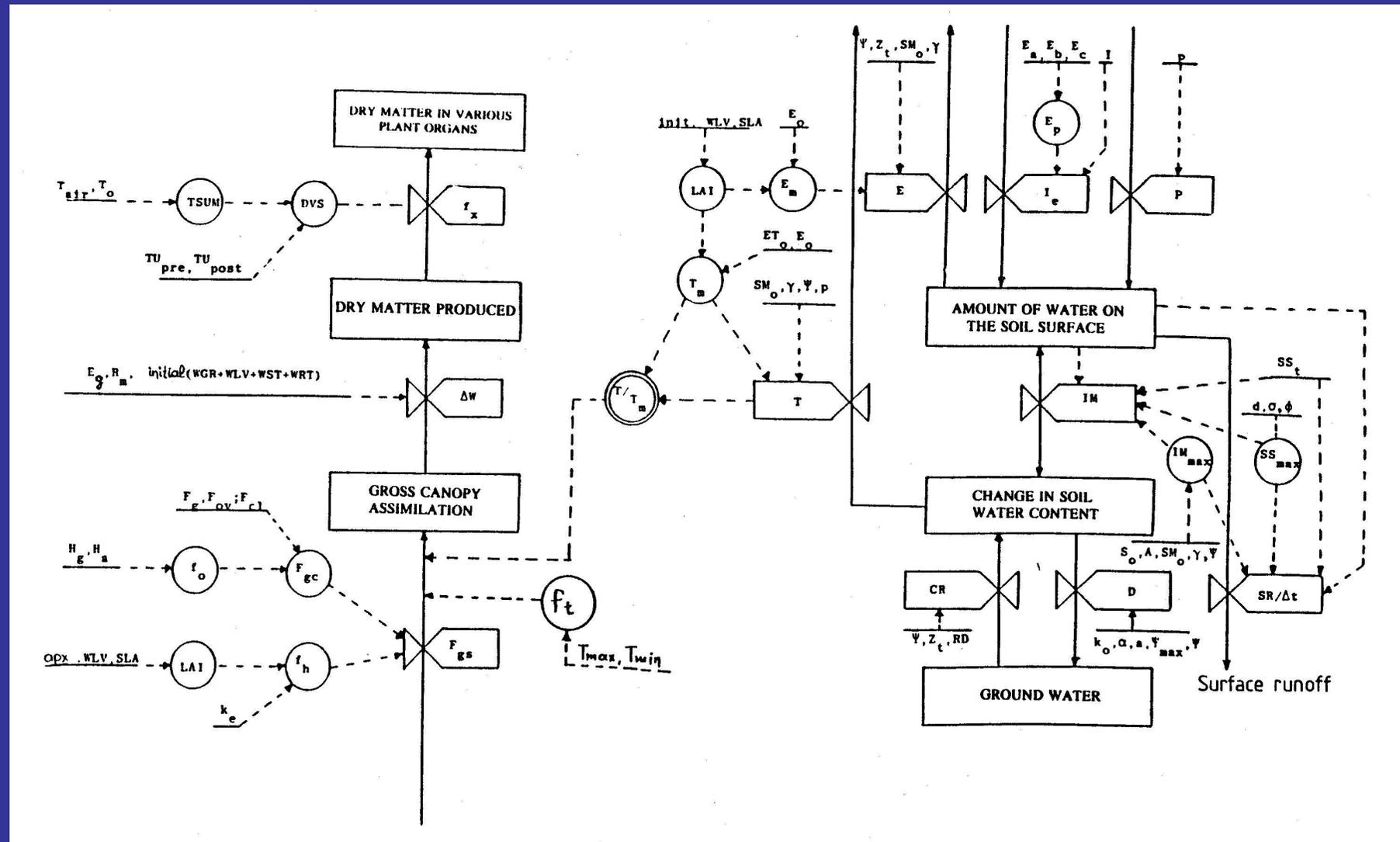
# BioKenaF: Relation diagram



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# BioKenaF: Relation Diagram



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# Application

## HARDWARE

- Processor: AMD ATHLON XP 2800+
- Motherboard: Gigabyte 7N400-Pro
- RAM: 1 GB 400 Mhz
- Hard disk: W.Digital 160 GB
- Graphics: GA 6600 GT 128 MB Ram

## SOFTWARE

- Microsoft Visual Basic 6
- Microsoft Excel 2000
- Helexis Icon Catcher v3.0
- Microsoft Paint for windows XP

## SIMULATION TIME

4 sec

13 sec including exportation to MS Excel



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# BioKenaF application

Interface

Input Form

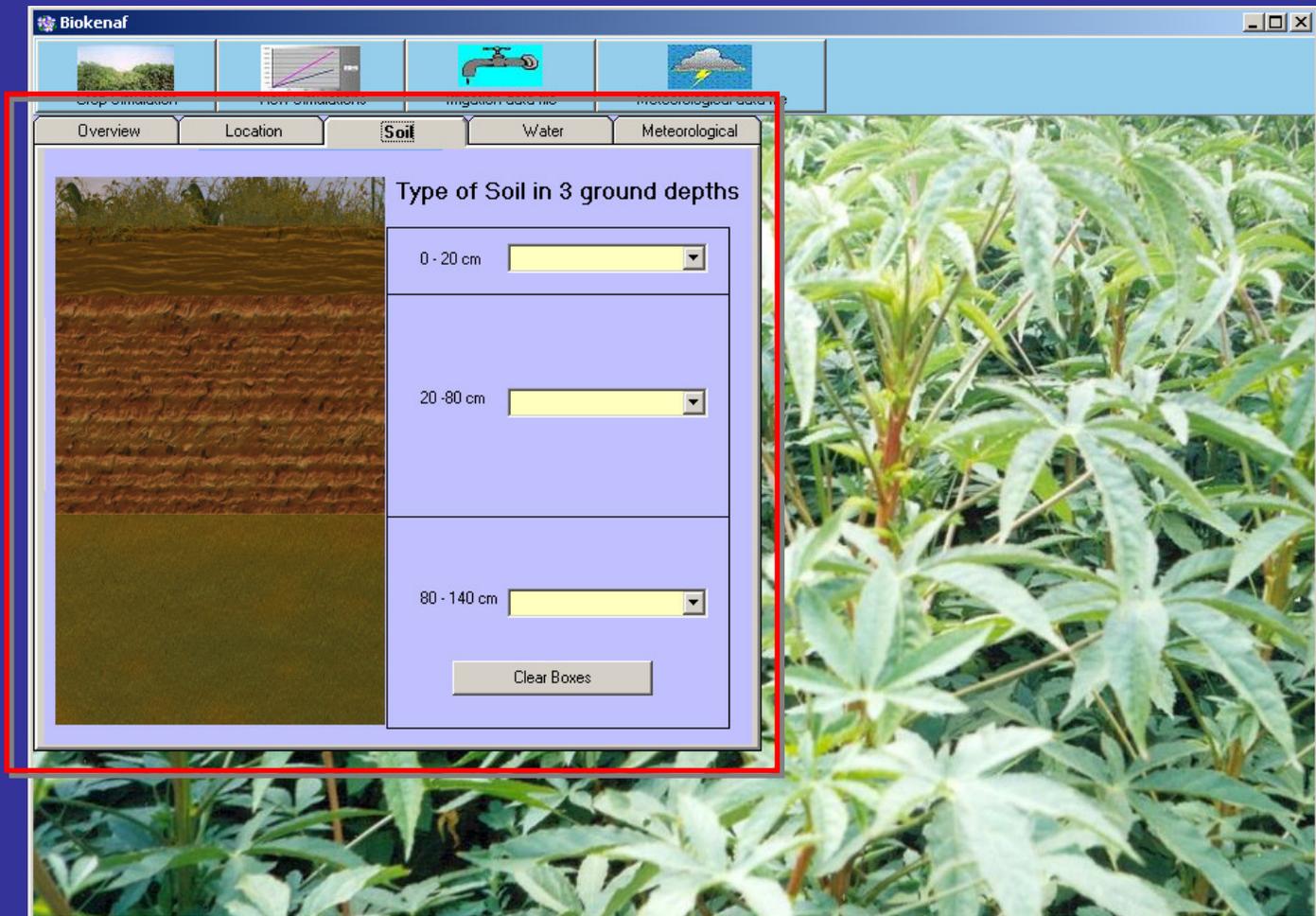
The screenshot displays the BioKenaF application window. At the top, there are four tabs: 'Crop Simulation', 'View Simulations', 'Irrigation data file', and 'Meteorological data file'. Below the tabs is a navigation bar with 'Overview', 'Location', 'Soil', 'Water', and 'Meteorological' sections. The main area is divided into two columns. The left column contains the 'SIMULATION CONDITIONS' section with radio buttons for 'Potential growth simulation' and 'Water-Limited Growth Simulation'. Below this are options for 'Fixed End-Day' (with a text input field), 'Maturity', and 'Anthesis'. The 'INPUTS' section includes fields for 'Initial Dry Weight' (kgr / ha), 'Day of emergence', 'Initial Sunction' (cm), 'Max. surface storage capacity' (cm), and 'Depth of Ground water' (cm) with a 'Permanent' checkbox. At the bottom of the left column are 'Save Inputs' and 'Load Inputs' buttons. The right column features a large yellow grid for data entry, with 'Save', 'Clear', 'SIMULATE', and 'Send to Excel' buttons above it. A background image of a corn plant is visible on the right side of the window.



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# BioKenaF application



Soil Type →  
Input Form



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# BioKenaF application

Irrigation  
Data  
Manager

The screenshot displays the BioKenaF application window. The main area is titled 'Irrigation Data Manager' and is divided into two sections. The left section is a calendar for the year 2006, specifically the month of September. The days of the week are listed as Sun, Mon, Tue, Wed, Thu, Fri, and Sat. The dates 1 through 30 are arranged in a grid. A red arrow points to the date 3. The right section is titled 'Add Irrigation in desirable intervals' and contains several input fields: 'From' (Year: 2000, Month: 2, Day: 1), 'Till' (Year: 2000, Month: 3, Day: 12), 'Every' (2 Days), and 'Irrigation' (5 cm). There is an 'Add to Calendar' button. Below this is the 'Optional File Informations' section, which includes fields for Author, Country, Area, Latitude, and Longitude, along with a 'Comments' field.



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# BioKenaF application

Editor of  
Meteorological  
Data Files



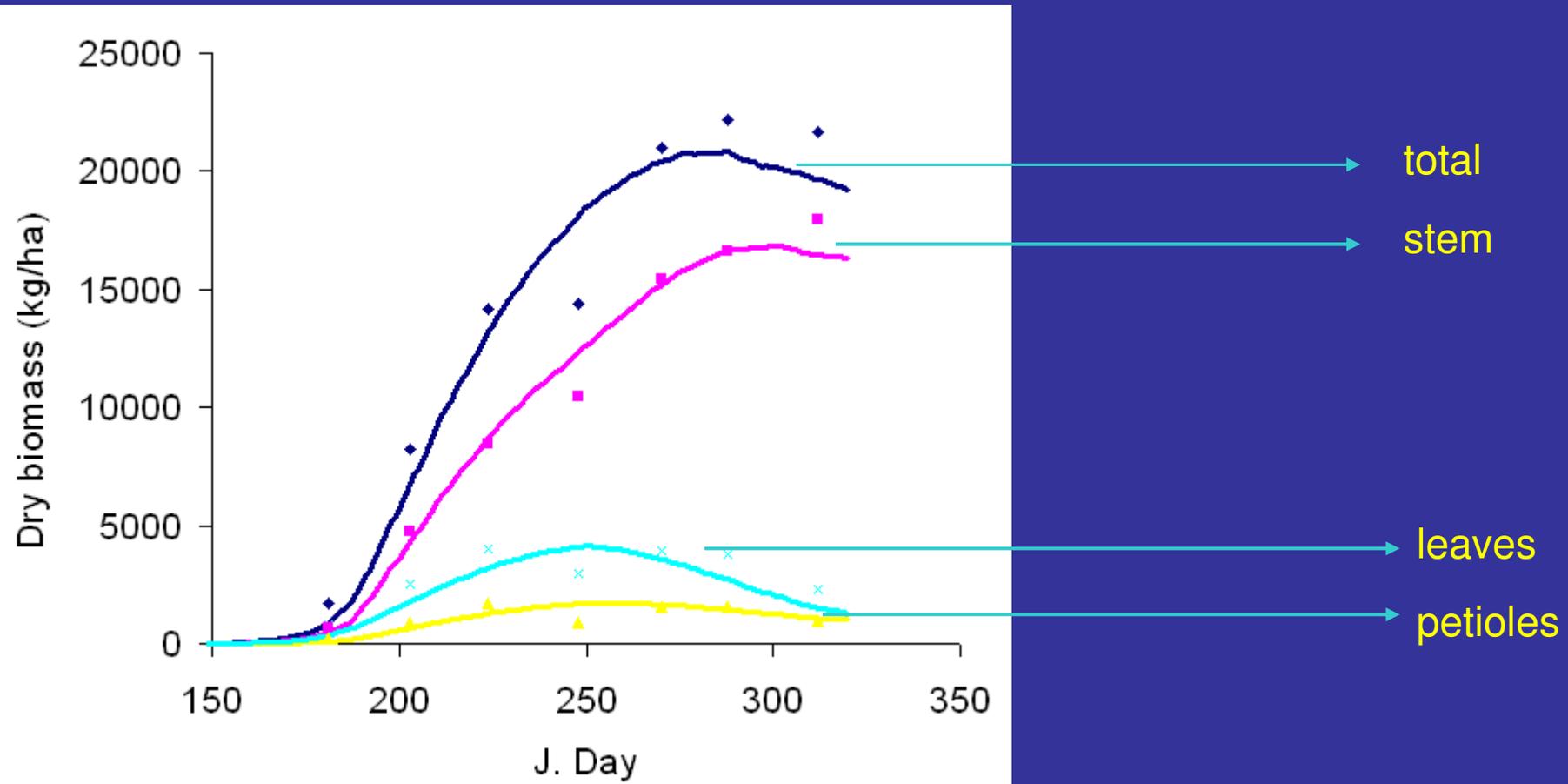
DAY	TMAX	TMIN	AWATT	PREC	WIND	RH
Jan	1					
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
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# Results



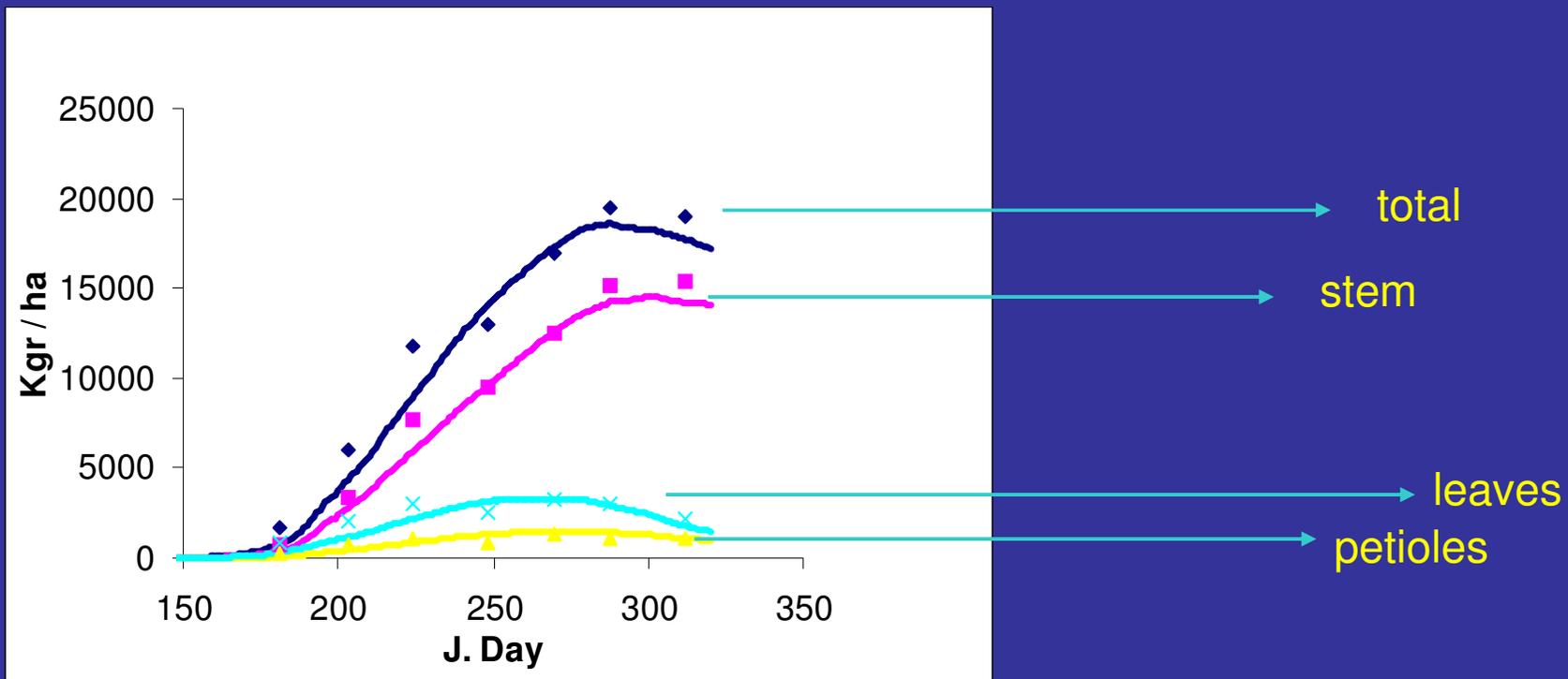
Palamas- Karditsa (Greece) Year 2003, 100% Irrigation



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# Results



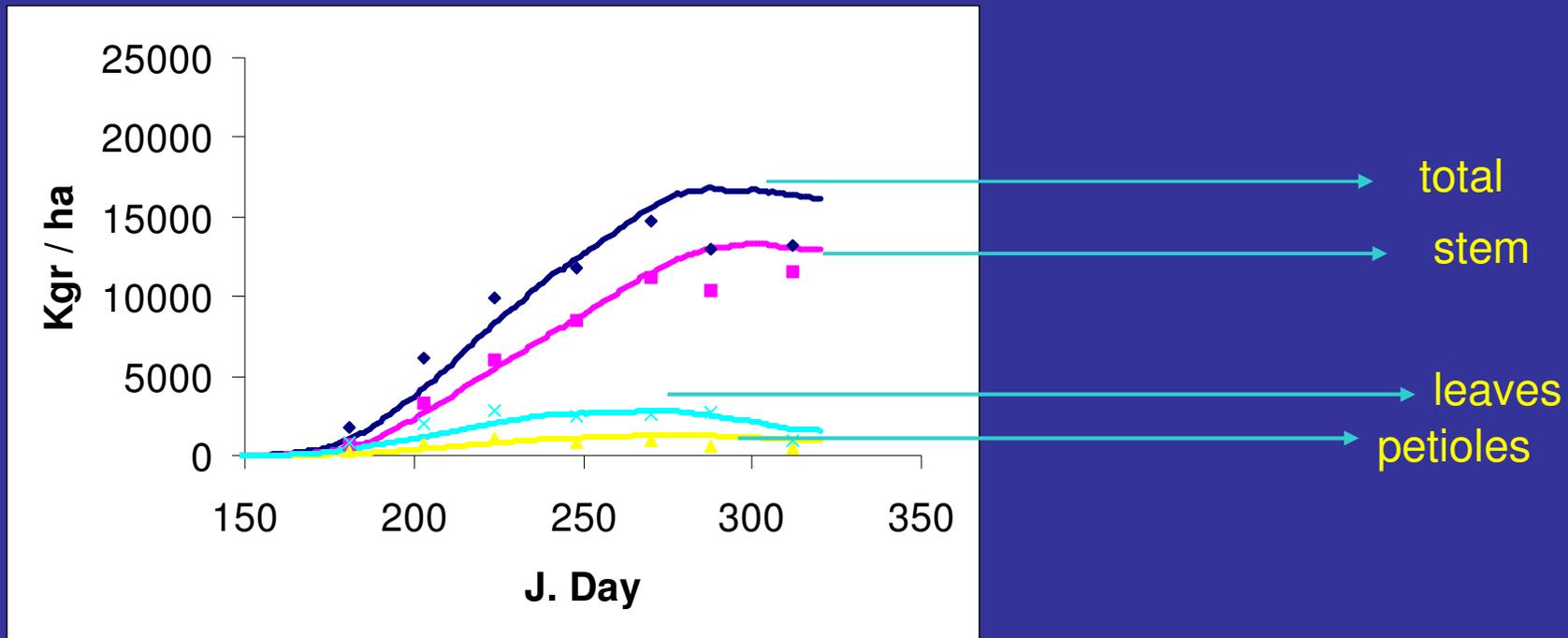
Palamas- Karditsa (Greece) Year 2003, 50% Irrigation



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# Results



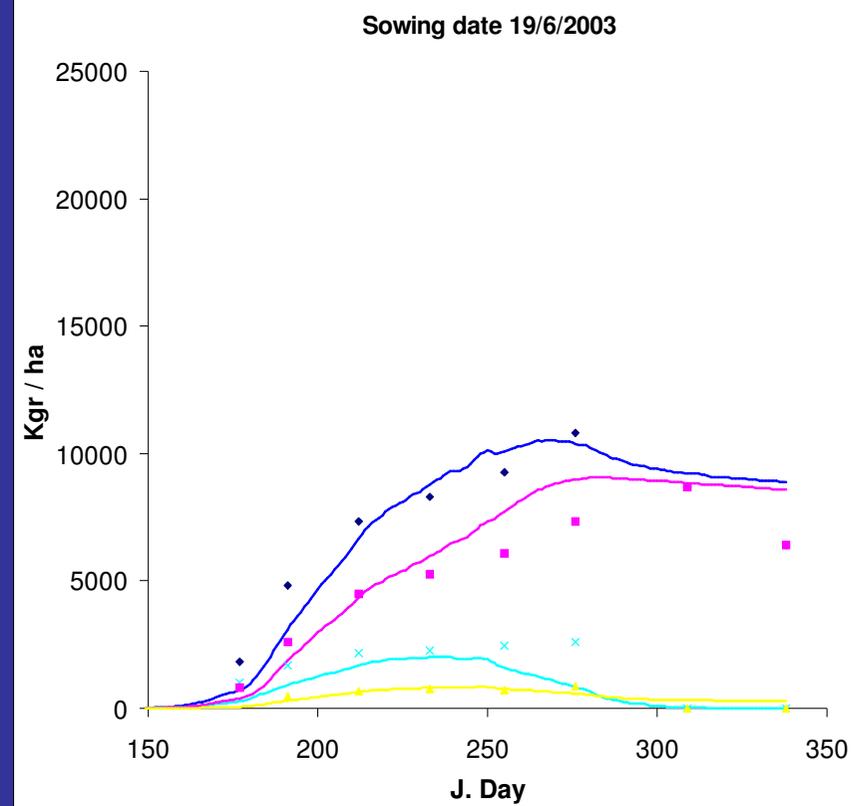
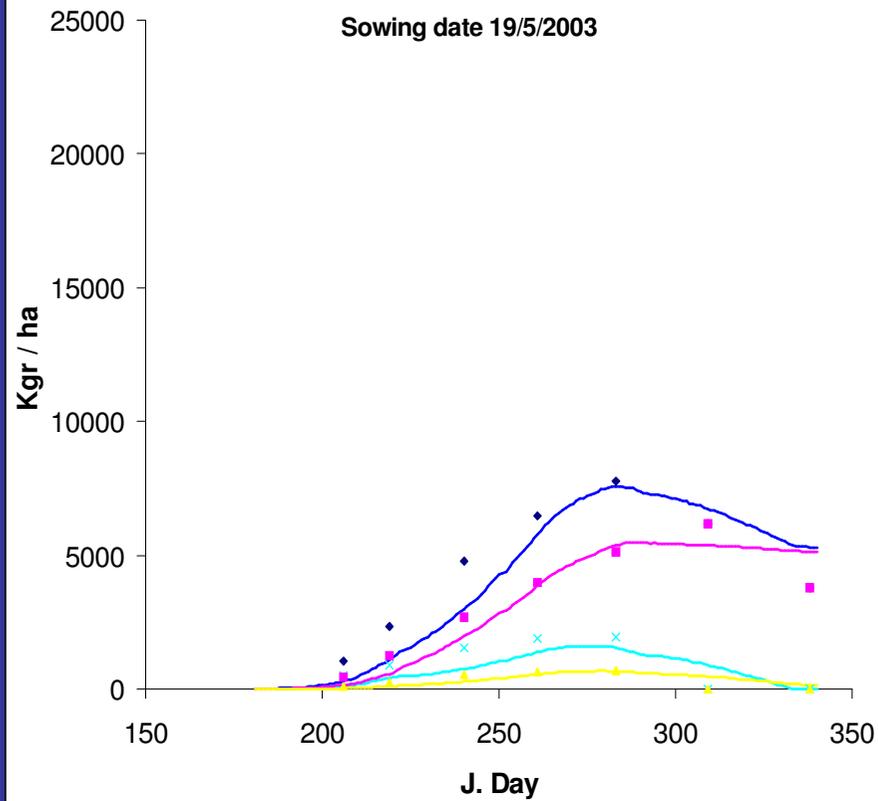
Palamas- Karditsa (Greece) Year 2003, 25% Irrigation



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# Results



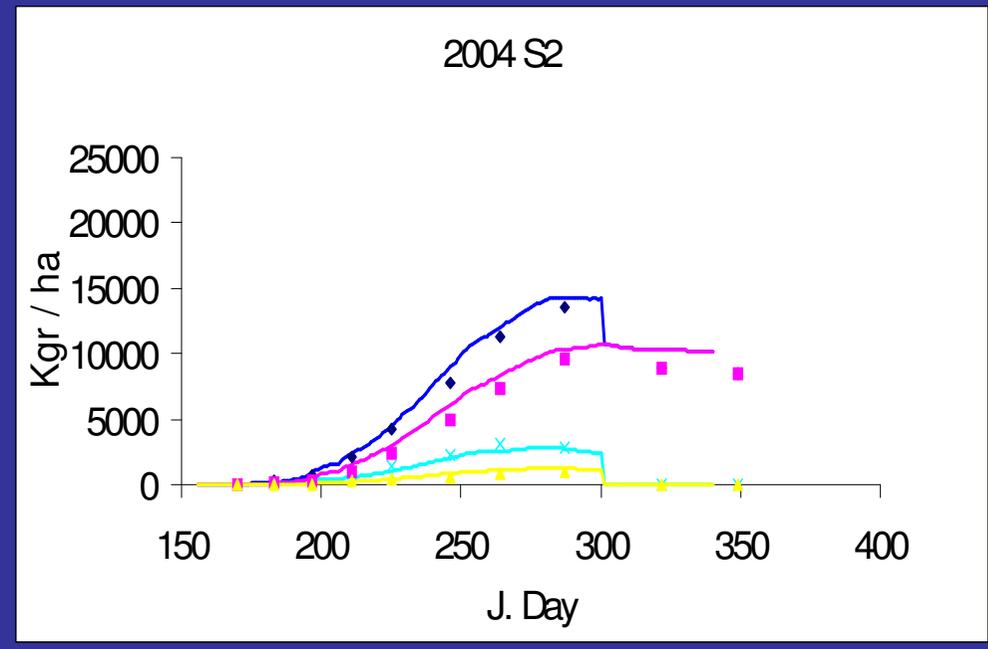
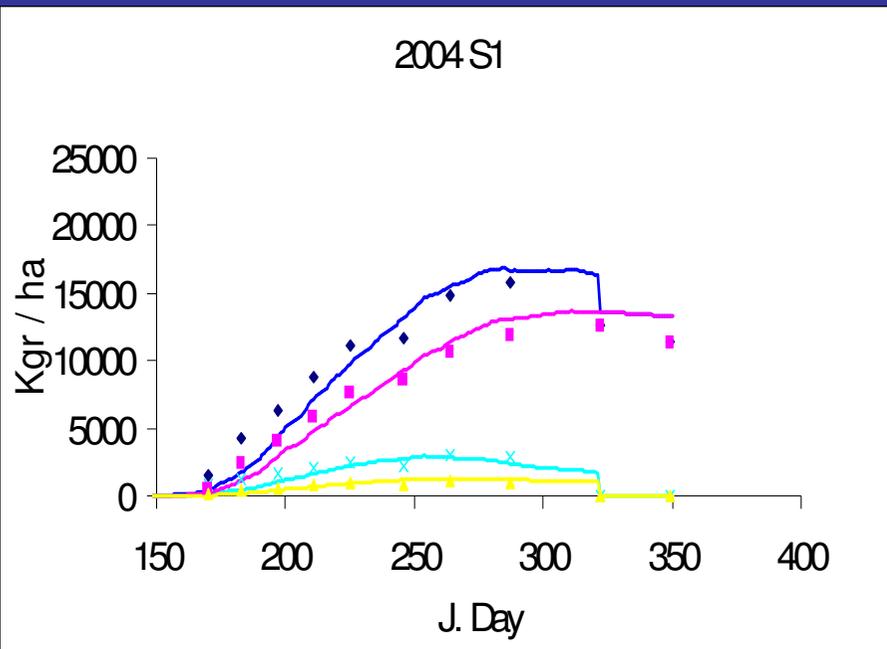
Italy Bologna Year 2003, potential productivity



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# Results



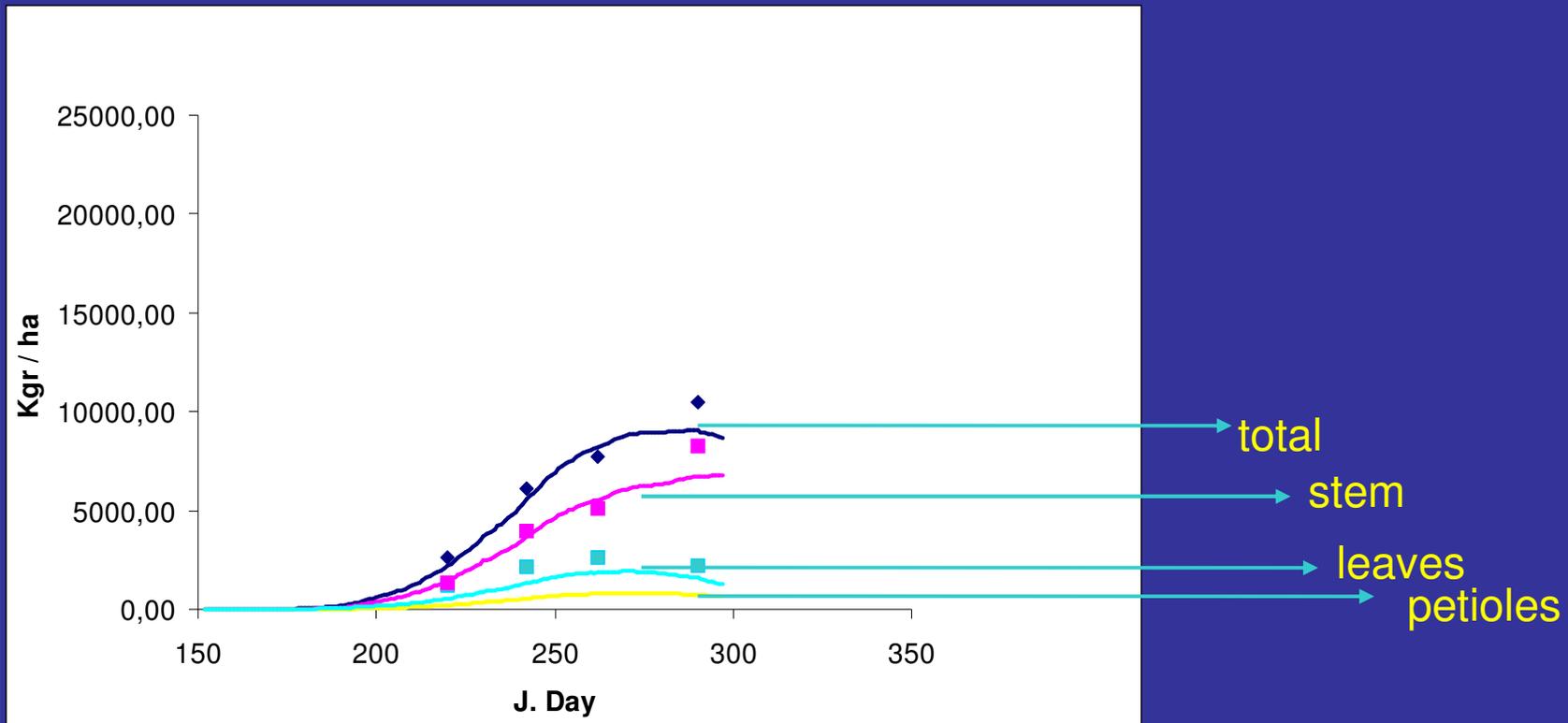
Italy Bologna Year 2004, potential productivity



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# Results



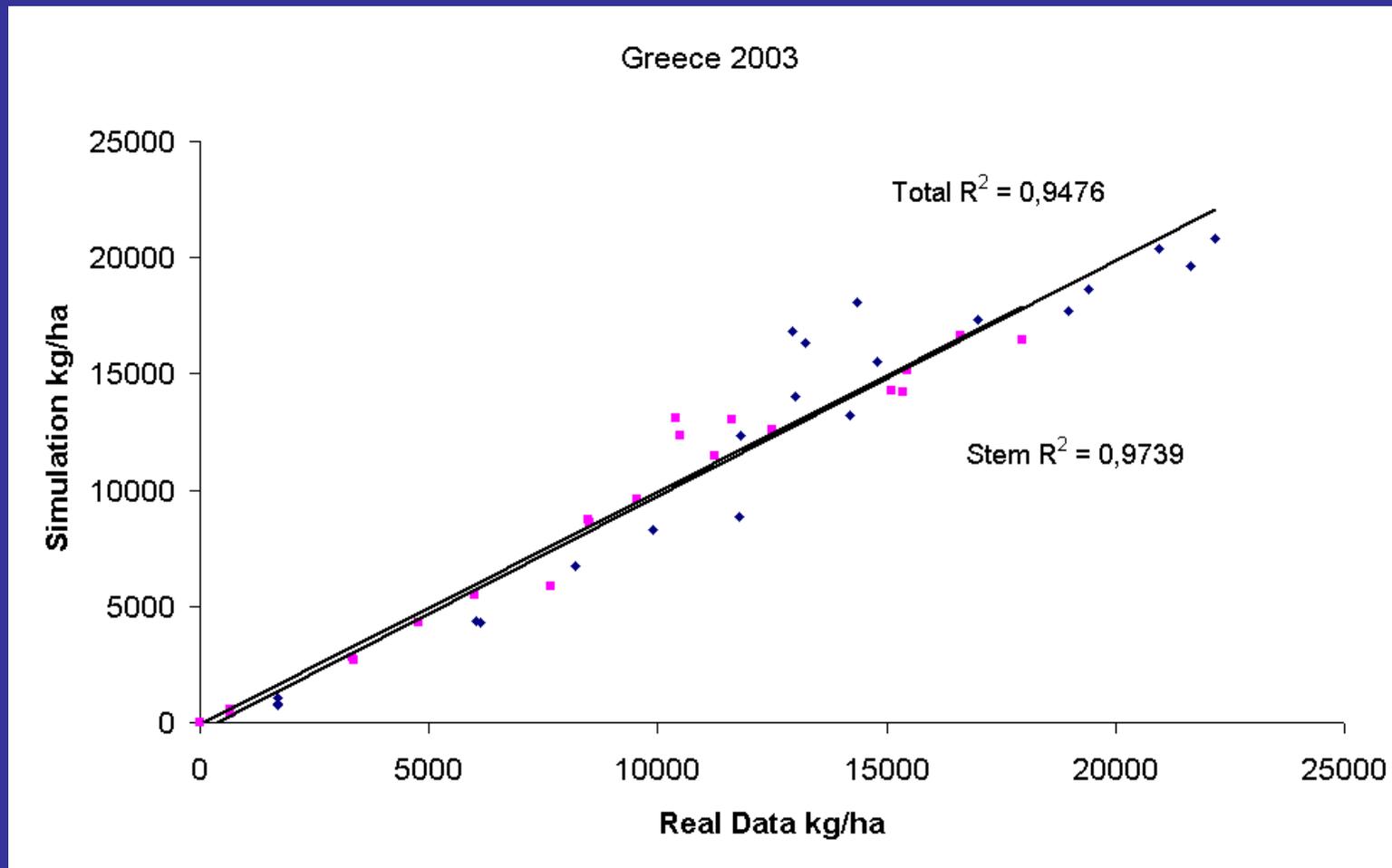
France- Nicae Year 2005, potential productivity



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# Results



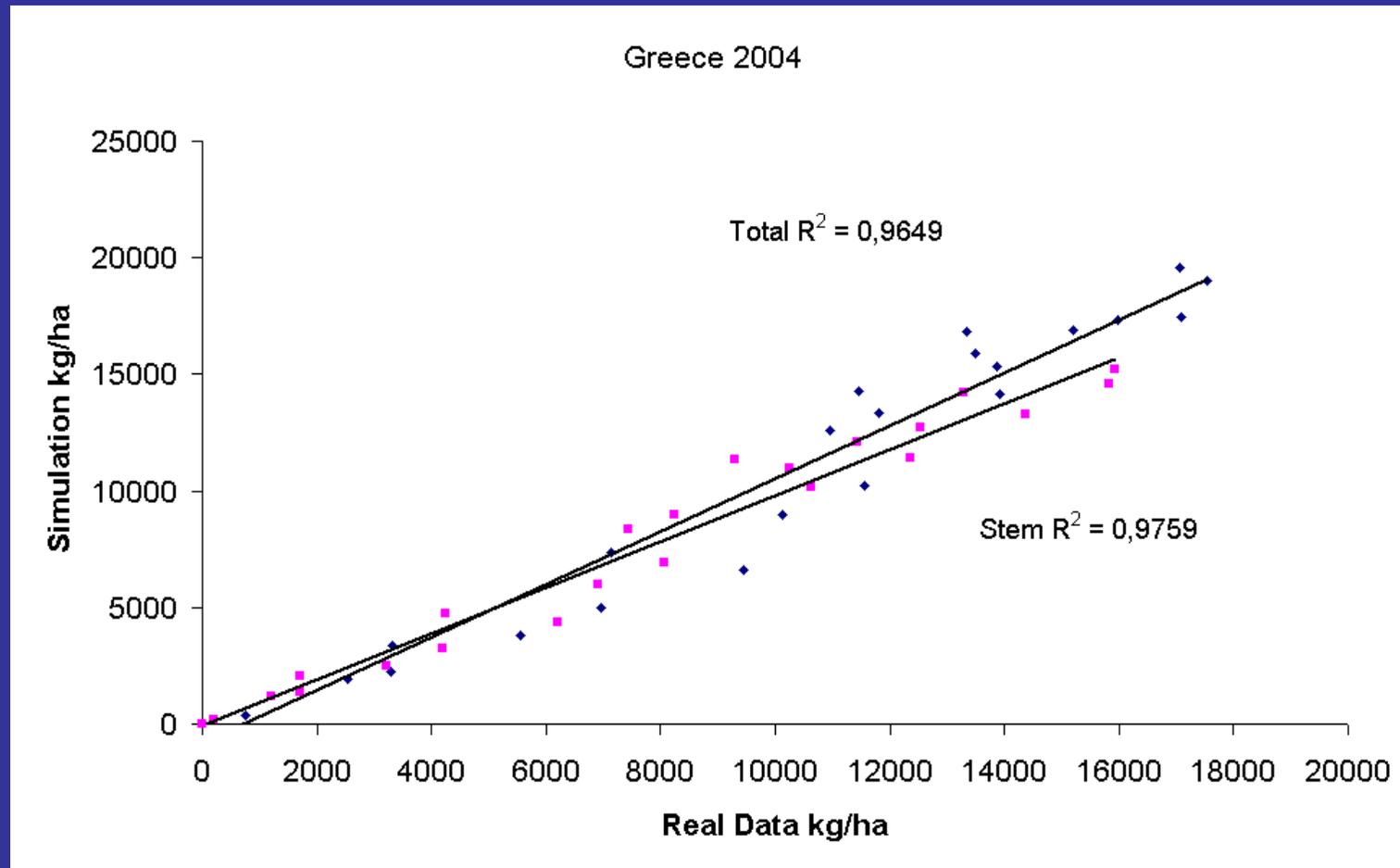
Greece Year 2003



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# Results



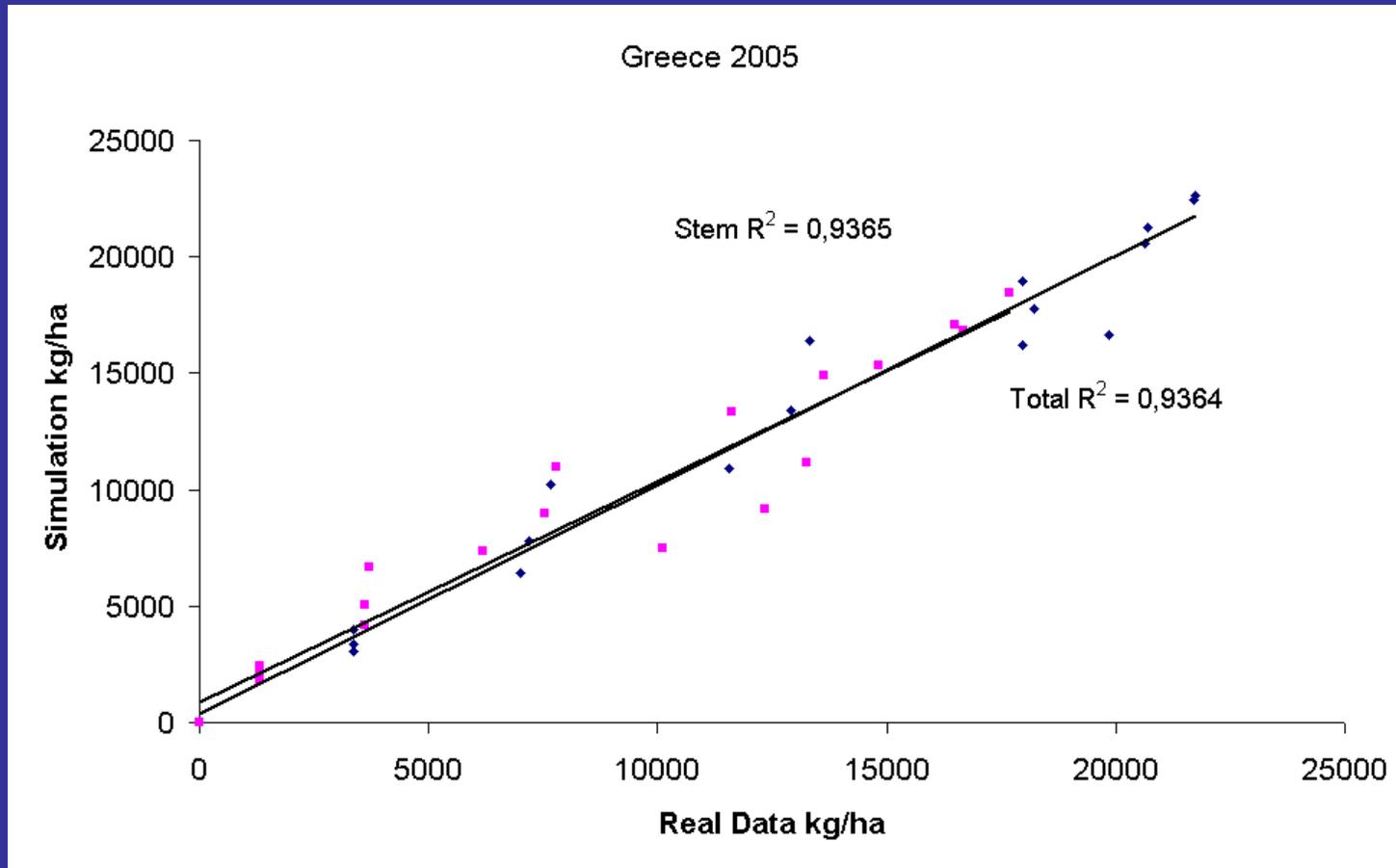
Greece Year 2004



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# Results



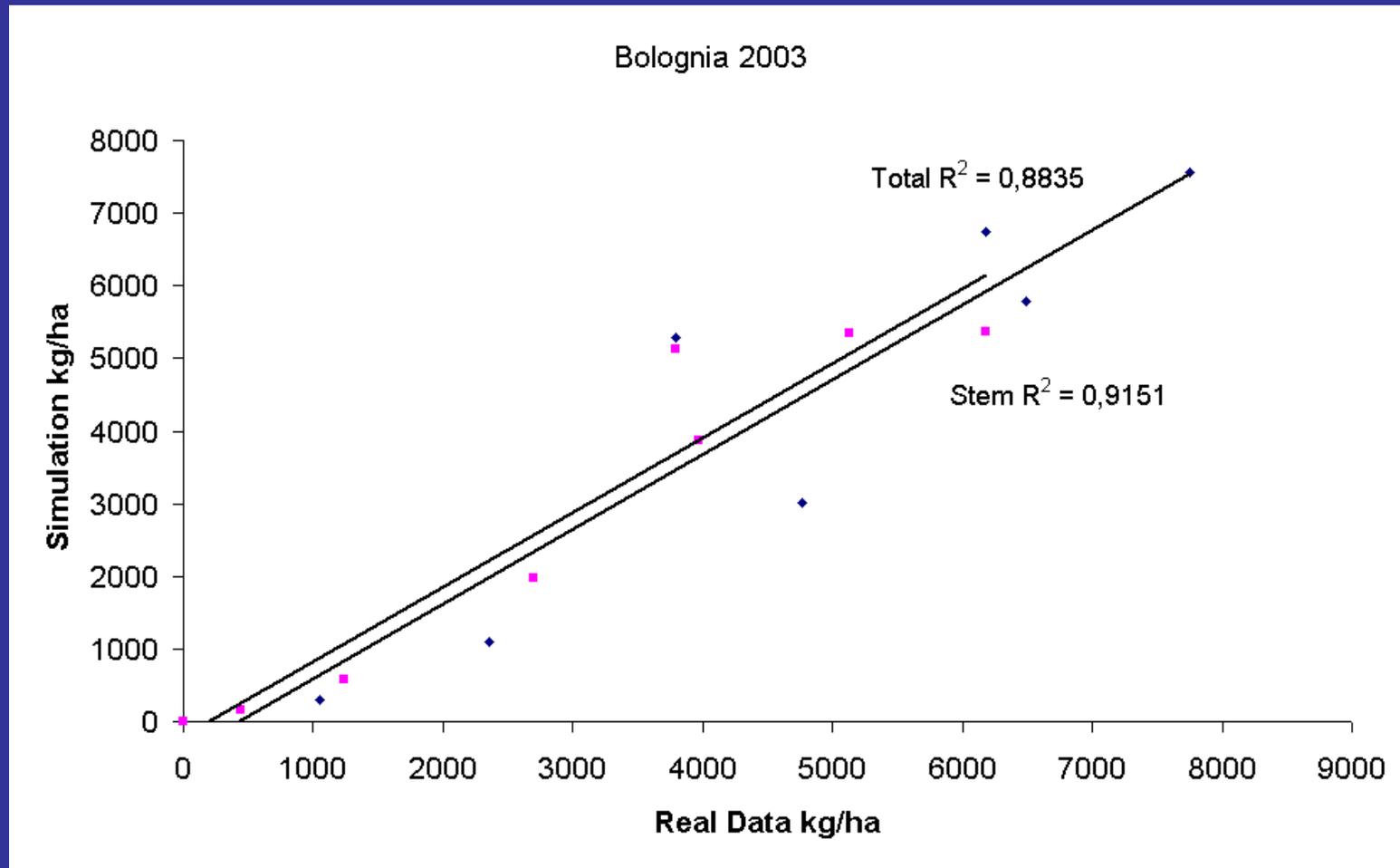
Greece Year 2005



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# Results



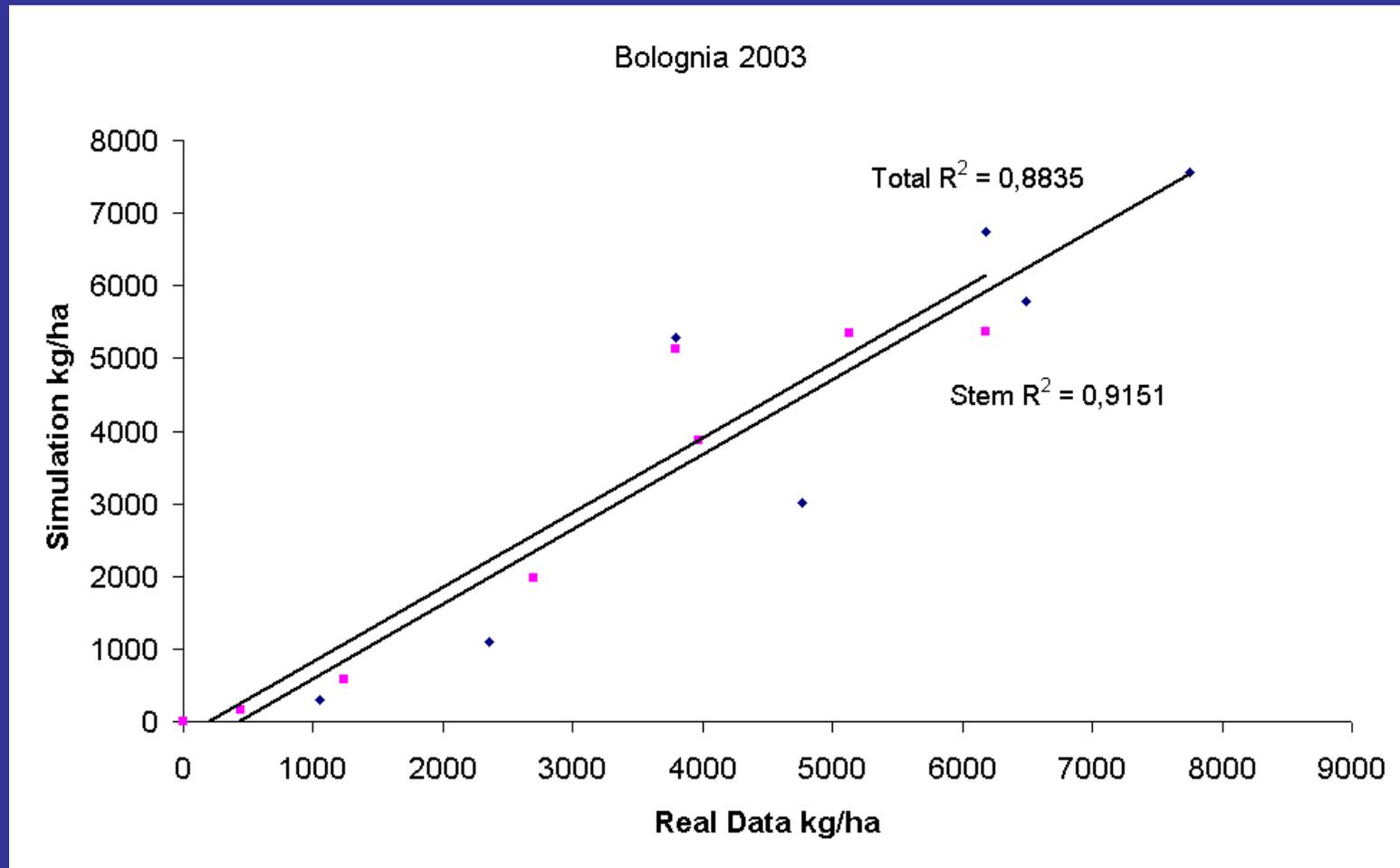
Bologna Year 2003



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# Results



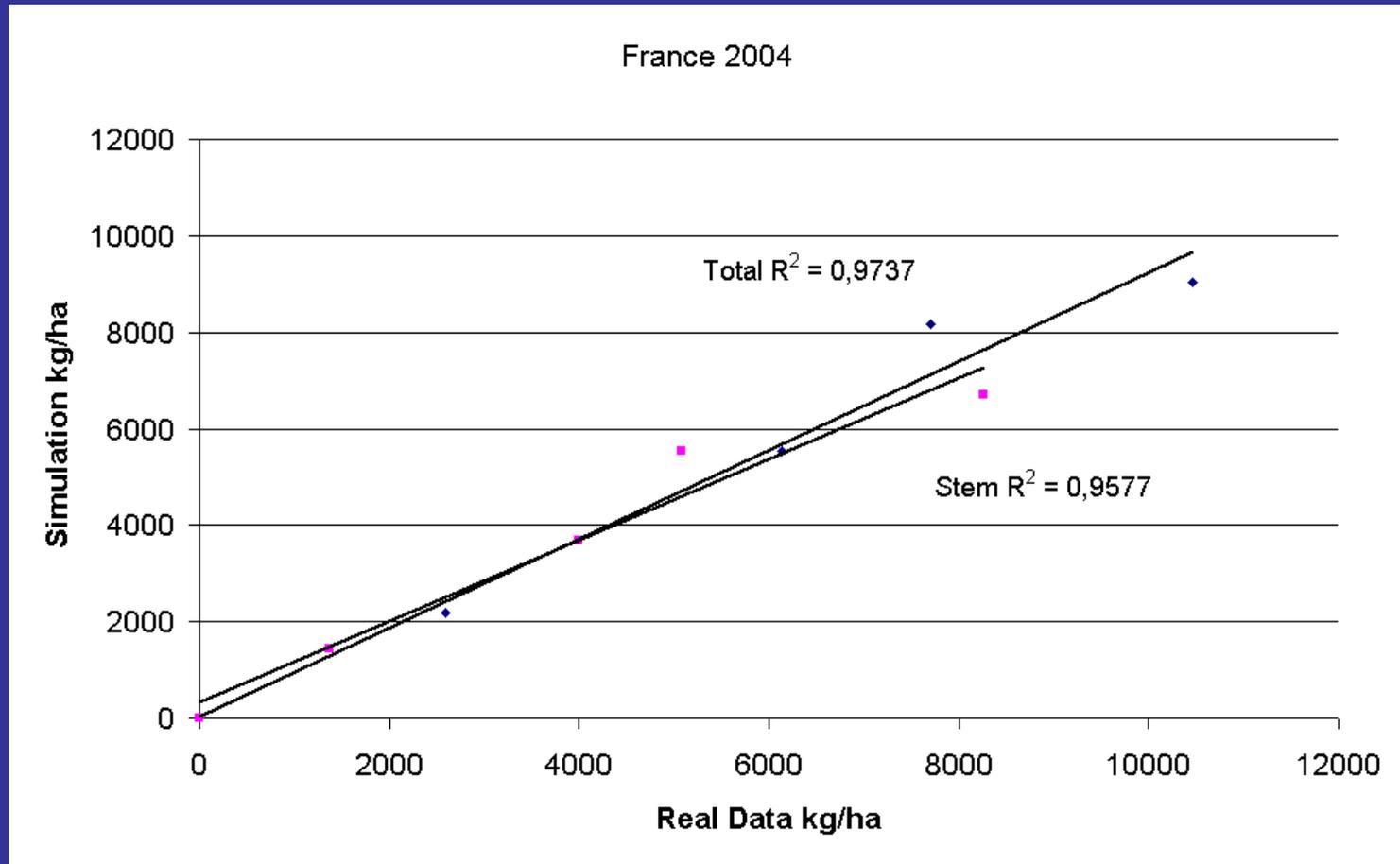
Bologna Year 2003



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# Results



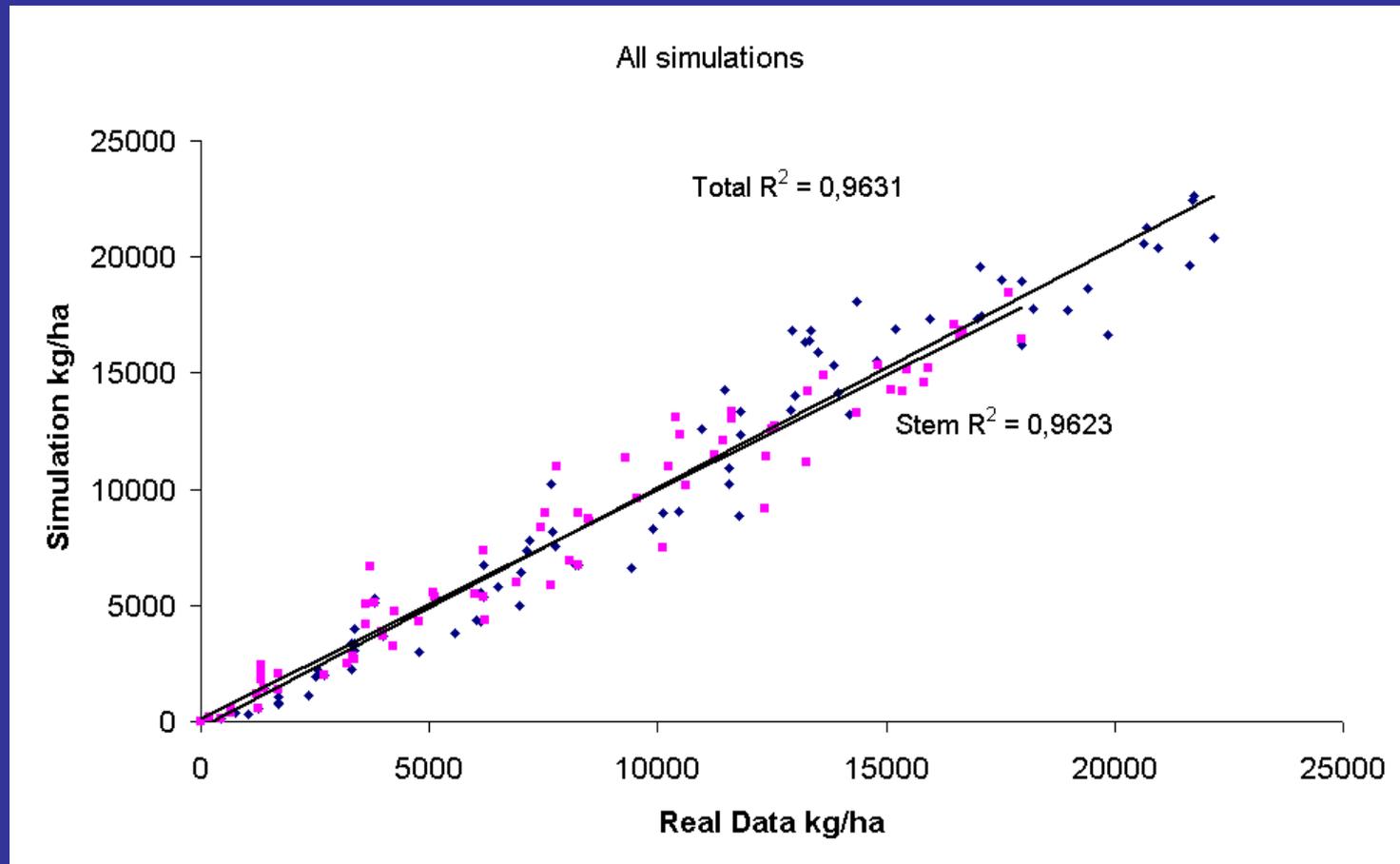
France Year 2004



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# Results



Summary



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# Missing Data

		Wheather										
Location	Year	TMAX	TMIN	Radiation	Precipitation	Wind	RH	Day of Emer.	Harvests	Irrigation	Soil Type	G. Water
Portugal	2003	X	X	X	X	X	X	X	X	X	X	X
	2004	X	X	X	X	X	X	X	X	X	X	X
	2005									X	X	X
Catania	2003			X		X					X	X
	2004			Problem							X	X
	2005										X	X
Spain	2003			X		X		X		X	X	X
	2004			X		X		X		X	X	X
	2005			X		X		X		X	X	X
Greece	2003			?				X	X	X	X	X
CETA	2004			?				X		X	X	X
	2005	X	X	?	X	X	X	X		X	X	X
France	2003	X	X	X	X	X	X	X	X		X	X
	2004	X	X	X	X	X	X	X	X		X	X



# Thank you for your attention !



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