

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

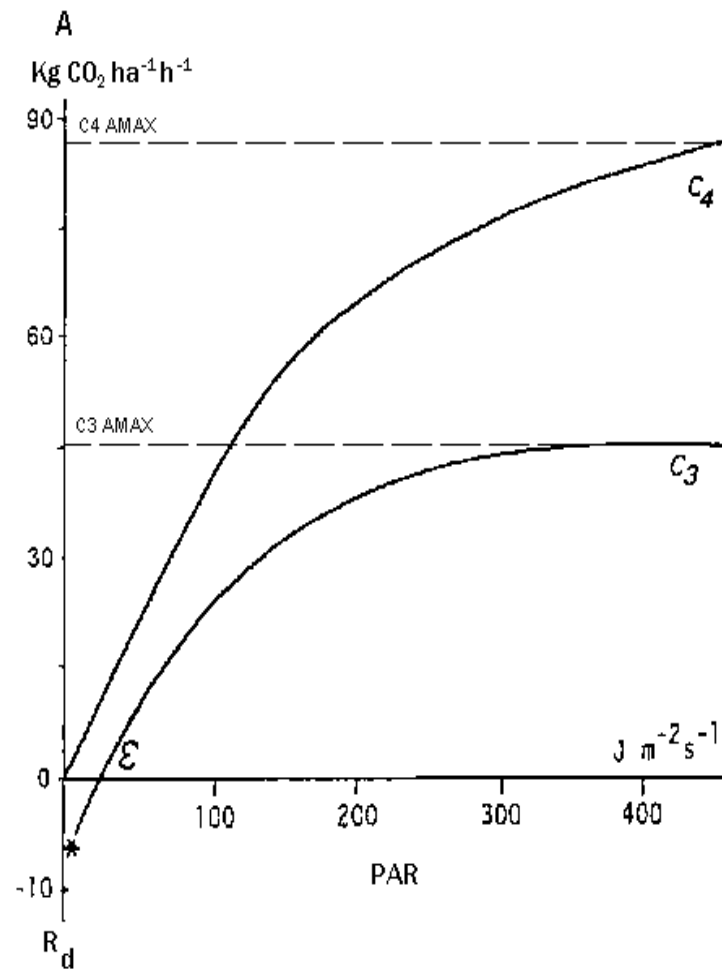
“A Crop Growth Dynamic Simulation Model for Kenaf”

Model structure

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



Leaf Photosynthesis



The relation between available radiation and CO₂ gross assimilation by a single leaf is described by an asymptotic exponential relation

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

FG: assimilation in kg(CO₂)ha⁻¹(leaf)h⁻¹

PAR: photosynthetically active radiation(J m⁻²s⁻¹)

EFF: is the light use efficiency in
kg ha⁻¹h⁻¹/J m⁻²s⁻¹

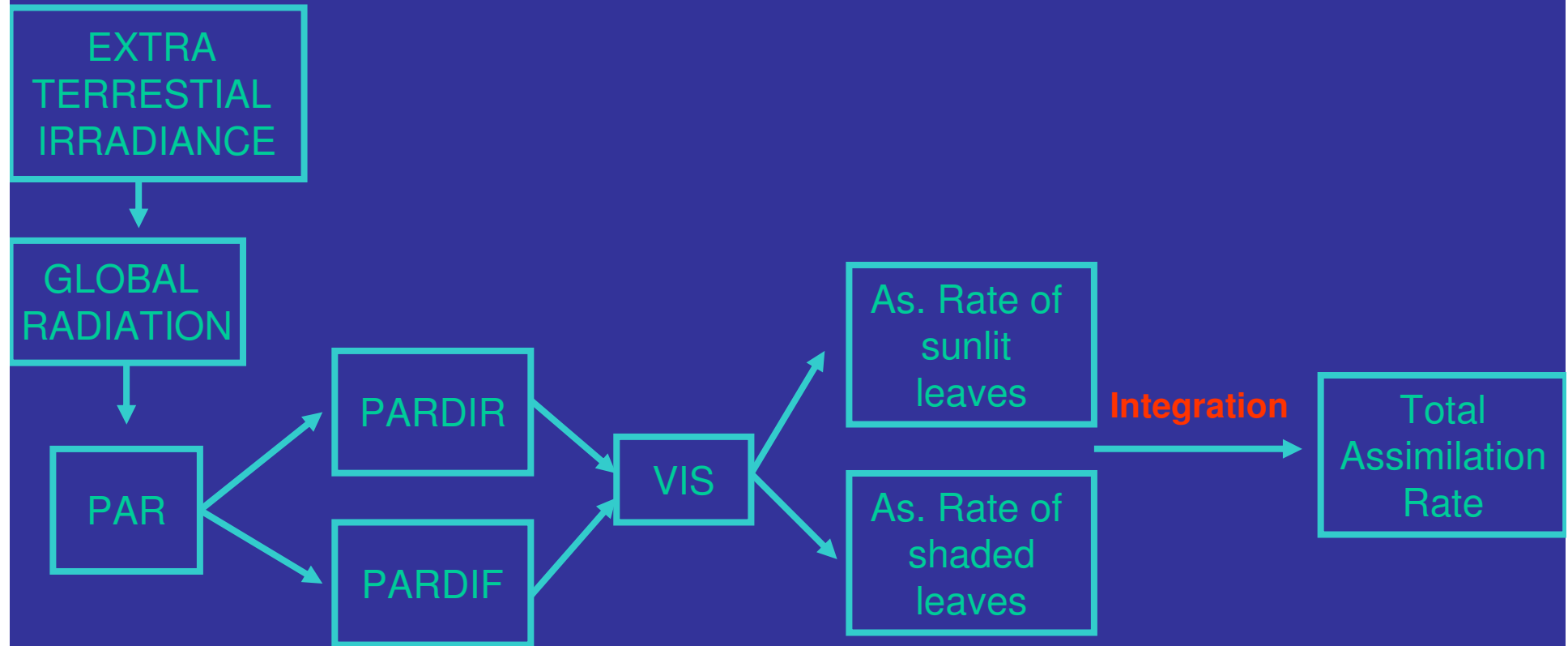
AMAX: maximum rate of CO₂ assimilation in
kg(CO₂)ha⁻¹(leaf)h⁻¹.



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Canopy Photosynthesis



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Respiration

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

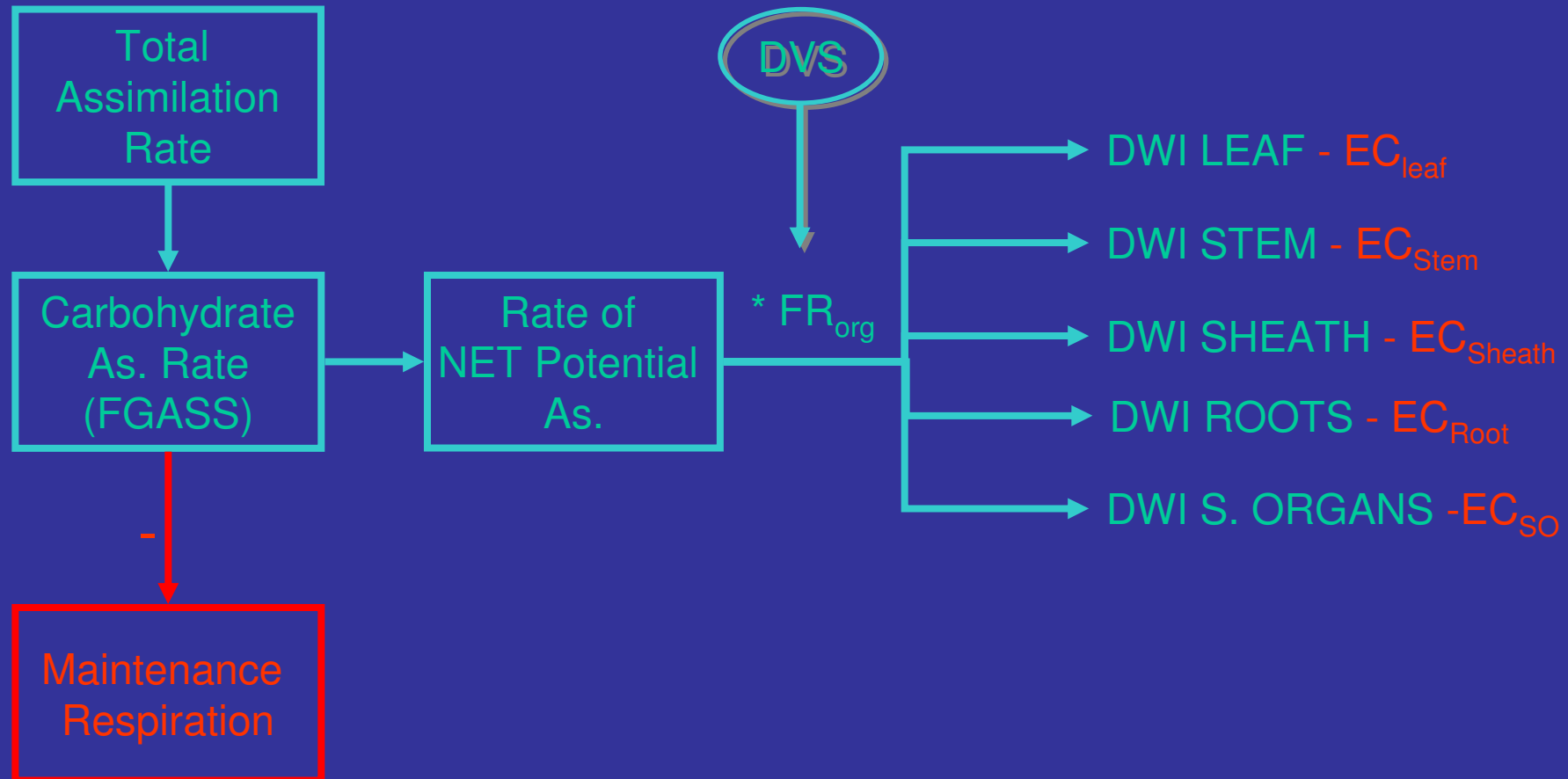
$$MRR_{org} = R_{org} * S_{org}$$

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

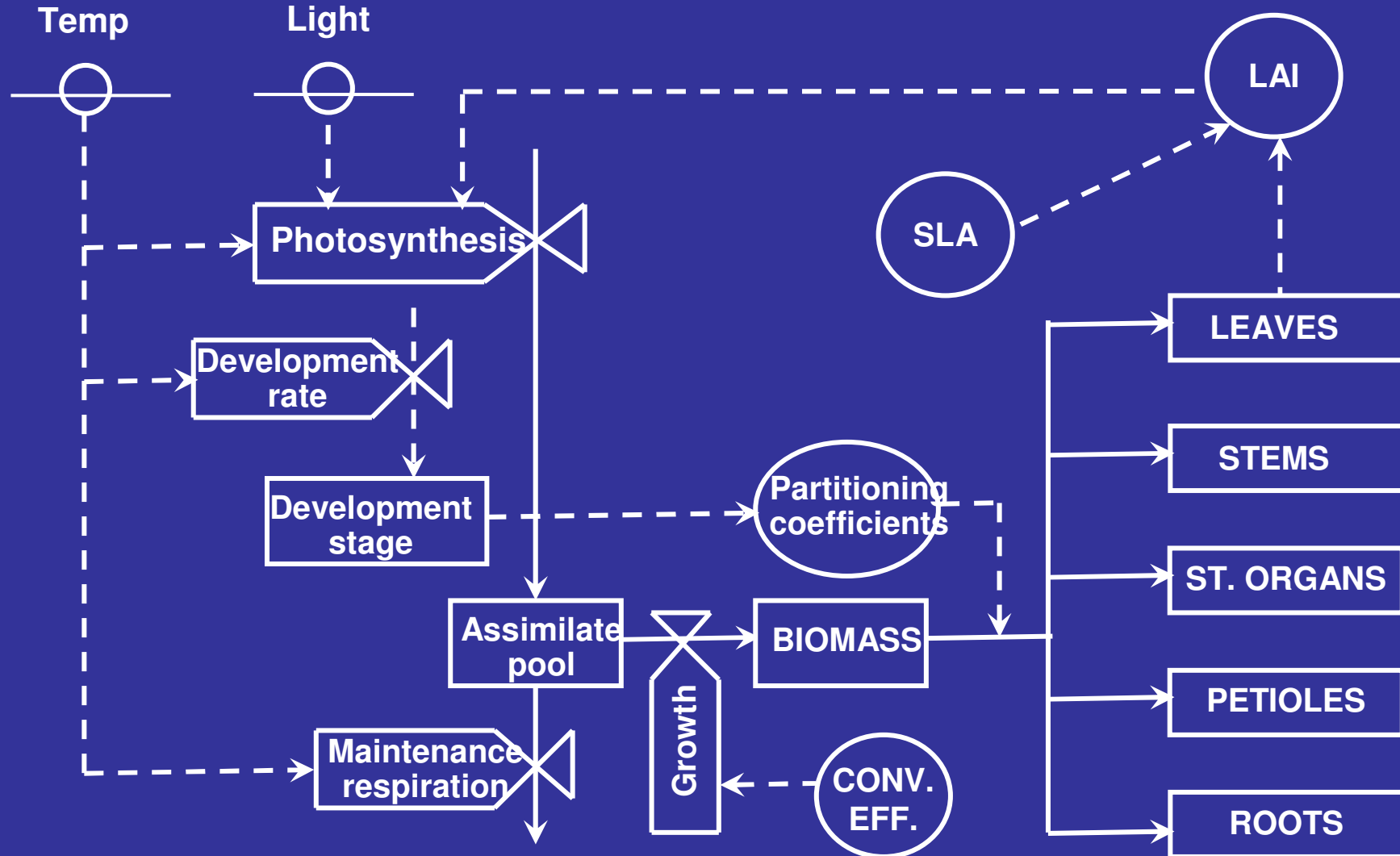
$$DWI_{org} = \text{DailyGain}_{org} * EC$$



Dry matter distribution (Daily basis)



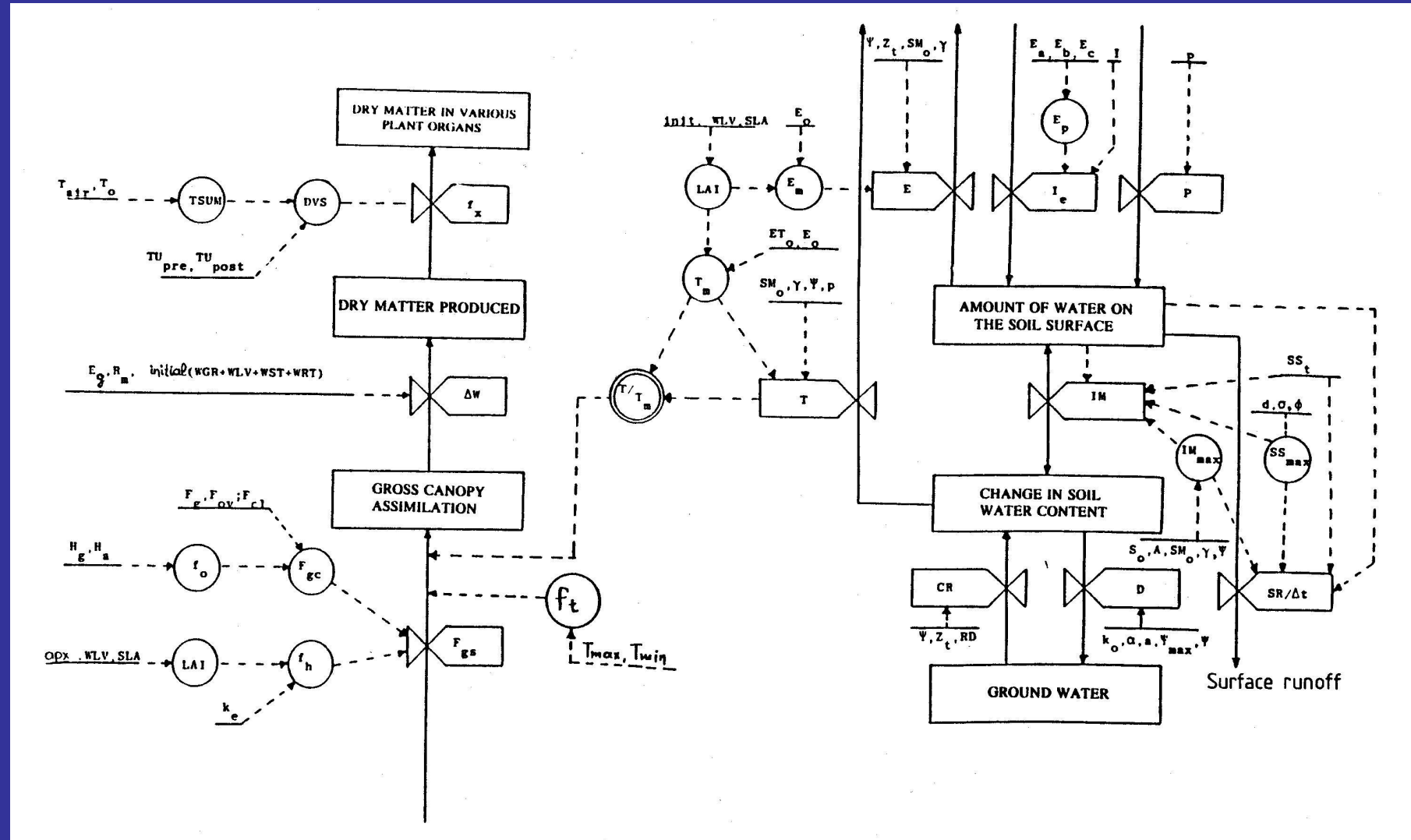
BioKenaF: Relation diagram



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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. The title bar reads "BioKenaF". Below the title bar is a menu bar with icons for "Crop Simulation", "View Simulations", "Irrigation data file", and "Meteorological data file". The main window is divided into several sections. On the left, there is a "SIMULATION CONDITIONS" section with radio buttons for "Potential growth simulation" and "Water-Limited Growth Simulation". Below this is a section for "Fixed End-Day" with a text input field and radio buttons for "Maturity" and "Anthesis". The "INPUTS" section contains fields for "Initial Dry Weight" (with unit "kgr / ha"), "Day of emergence", "Initial Sunction" (with unit "cm"), "Max. surface storage capacity" (with unit "cm"), and "Depth of Ground water" (with unit "cm" and a "Permanent" checkbox). At the bottom left are "LOAD / SAVE INPUTS" buttons for "Save Inputs" and "Load Inputs". On the right, there is a large yellow grid for data entry. Above the grid are buttons for "Save", "Clear", "SIMULATE", and "Send to Excel". The right side of the window features a vertical strip showing a close-up image of green leaves.

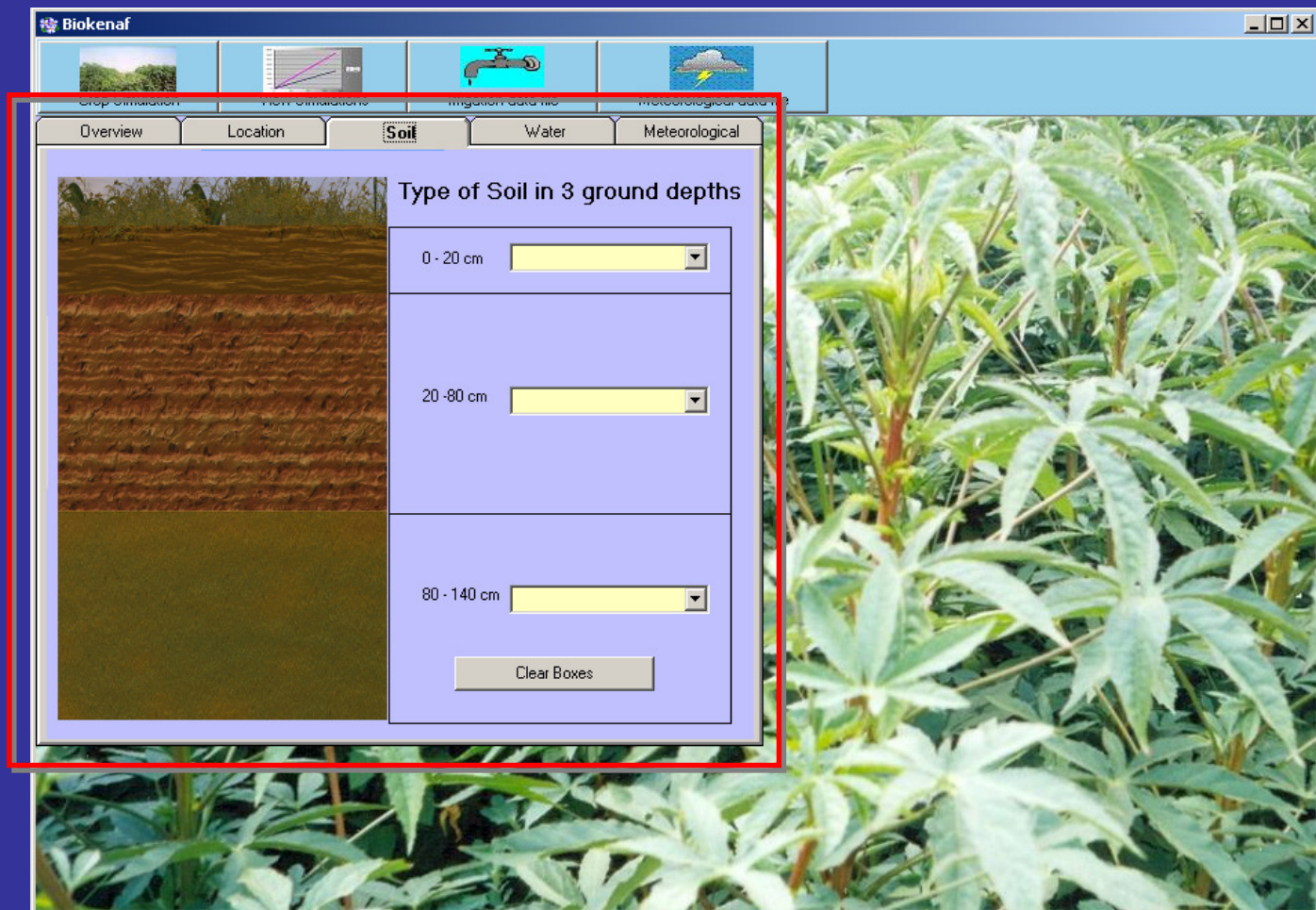


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BioKenaF application

Soil Type →
Input Form



The screenshot displays the BioKenaF application window. The title bar reads "BioKenaF". Below the title bar is a menu bar with icons for "Crop simulation", "View simulation", "Irrigation data", and "Meteorological data". Below the menu bar is a tabbed interface with tabs for "Overview", "Location", "Soil", "Water", and "Meteorological". The "Soil" tab is currently selected. The "Soil" tab contains a section titled "Type of Soil in 3 ground depths". To the left of this section is a vertical image showing three distinct soil layers: a top layer of dark brown soil, a middle layer of lighter brown soil, and a bottom layer of dark green soil. To the right of the image are three dropdown menus for selecting soil types at different depths: "0 - 20 cm", "20 - 80 cm", and "80 - 140 cm". Below these dropdowns is a "Clear Boxes" button. The background of the application window shows a field of green cassava plants.



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BioKenaF application

Irrigation
Data
Manager

BioKenaF

Drop simulation | Non-simulation | Irrigation data file | Meteorological data file

Create | Load

< 2006 > < September > Save Data

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Add Irrigation in desirable intervals

Year Month Day
From: 2000 / 2 / 1
Till: 2000 / 3 / 12
Every: 2 Days Irrigation 5 cm
Add to Calendar

Optional File Informations

Author: _____ Comments: _____
Country: _____
Area: _____
Latitude: _____
Longitude: _____



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BioKenaF application

Editor of
Meteorological
Data Files



The screenshot shows the 'Meteorological files editor' window. It features a menu bar with 'File', 'Grid', and 'Help'. The main area is a table with columns: DAY, TMAX, TMIN, AWATT, PREC, WIND, and RH. The 'DAY' column lists days from 1 to 23, with 'Jan' in the first row. The other columns are empty. To the right of the table is a panel with input fields for 'Year', 'Author', 'Country', 'Area', 'Latitude', 'Longitude', and 'Altitude'. Below these is a 'Comments' section with a text area. At the bottom right, there is a section titled 'Insert a stable value within an interval' with fields for 'Month', 'From Day', 'Till Day', 'Column', and 'Value'. Two buttons, 'Linear interpolation' and 'Insert values', are at the bottom.

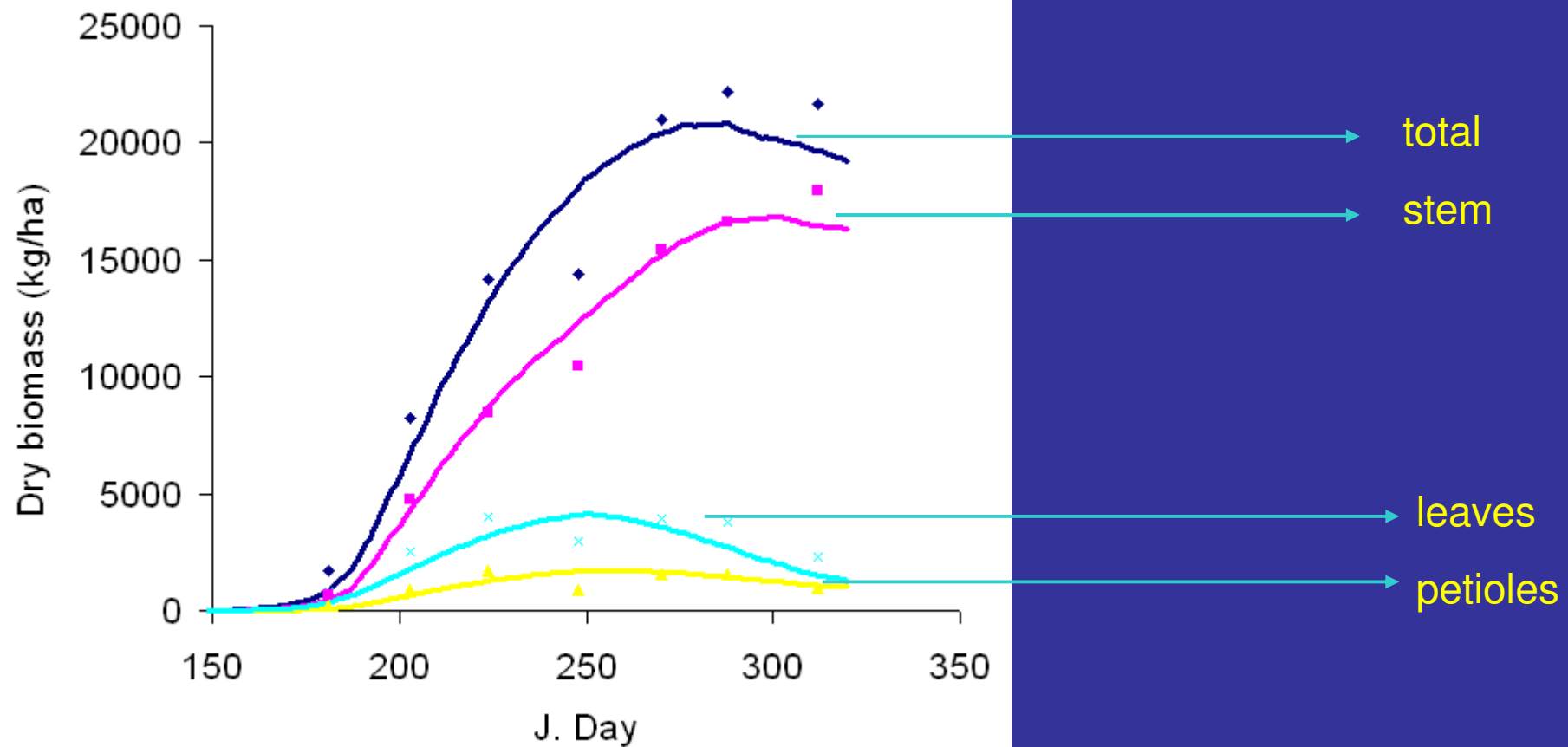
DAY	TMAX	TMIN	AWATT	PREC	WIND	RH
Jan 1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						



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Results



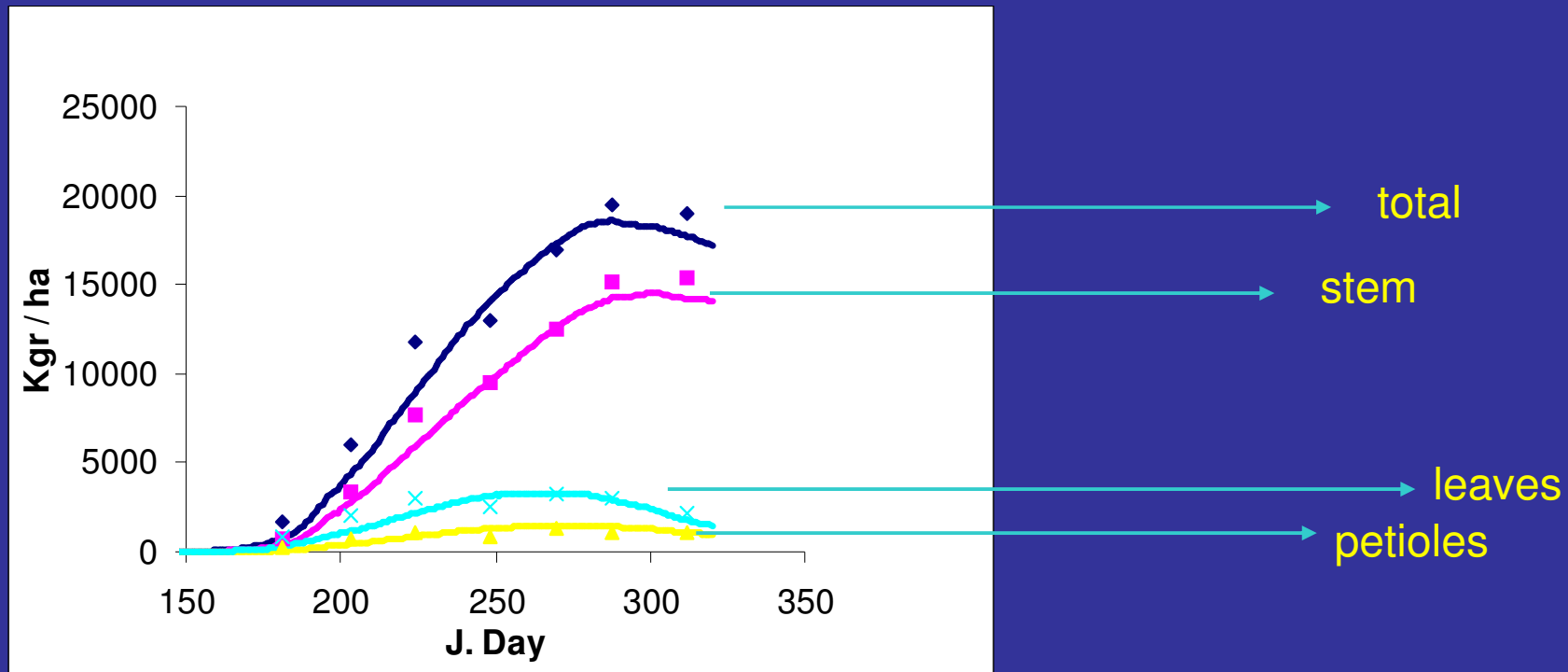
Palamas- Karditsa (Greece) Year 2003, 100% Irrigation



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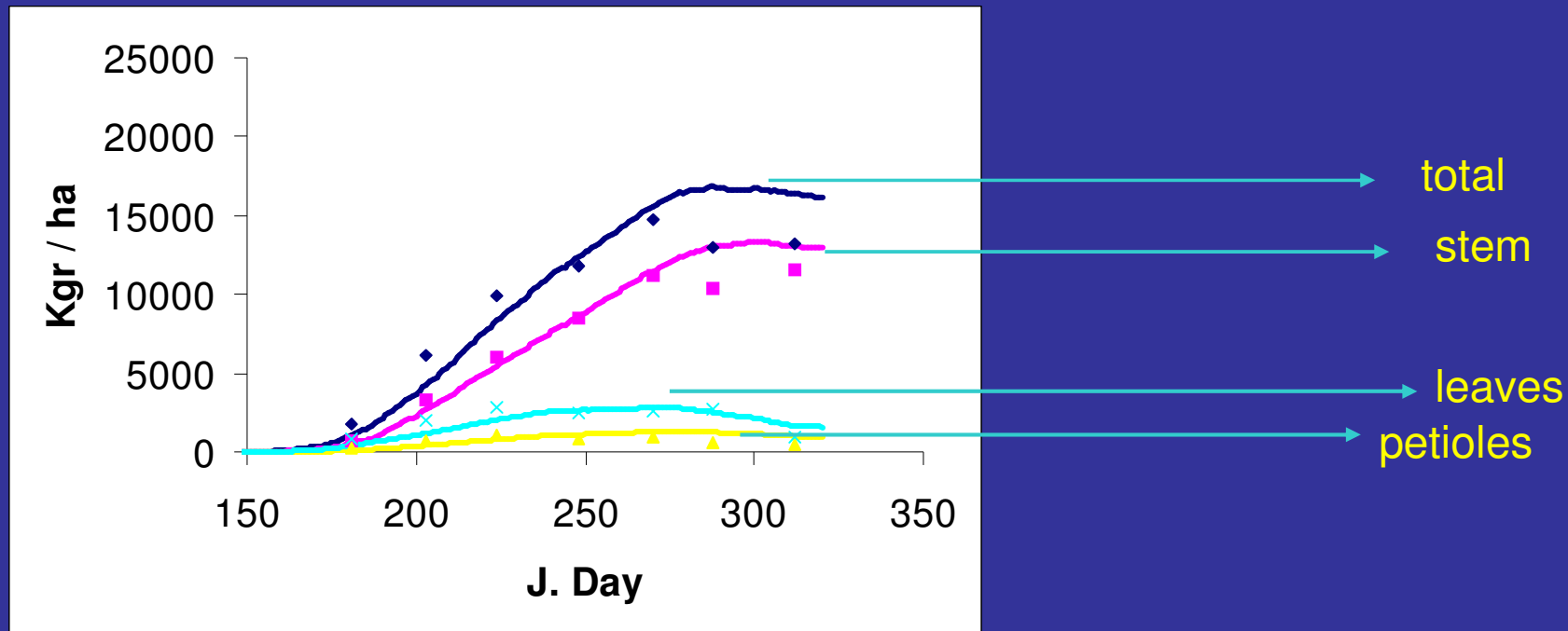
Palamas- Karditsa (Greece) Year 2003, 50% Irrigation



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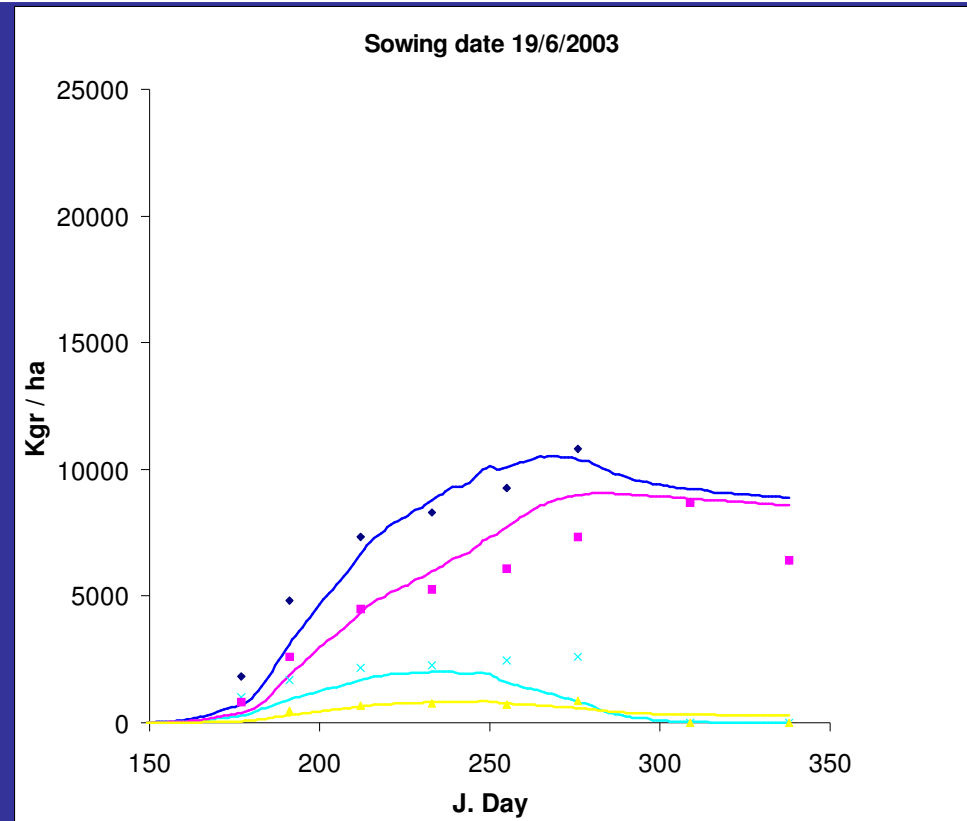
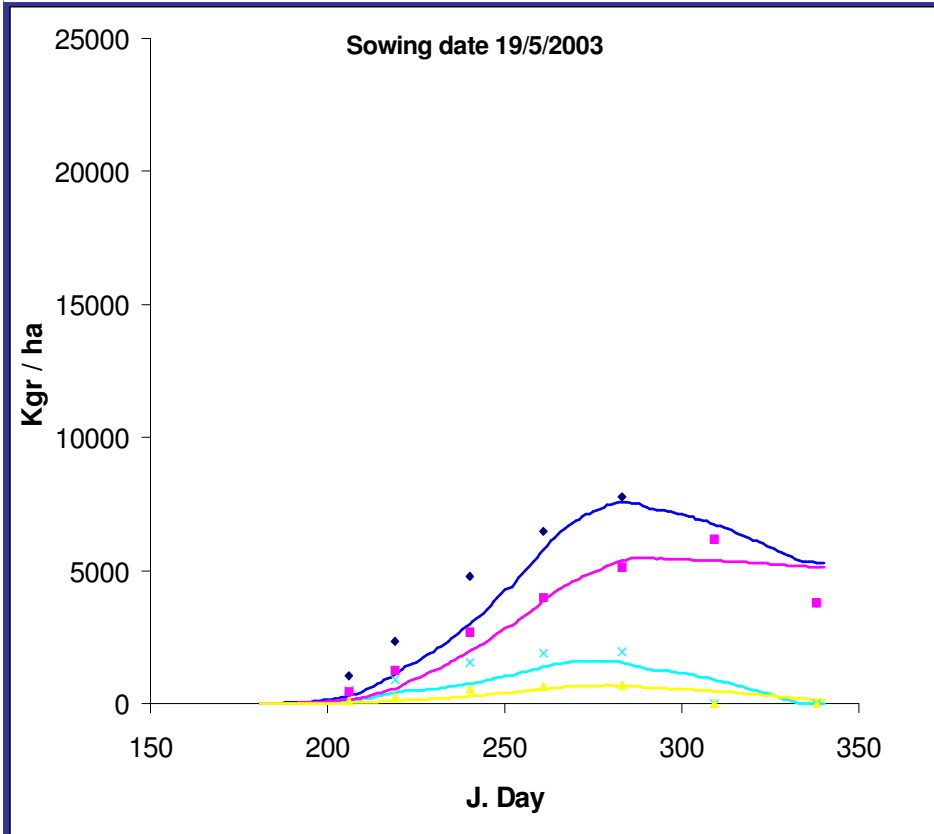
Palamas- Karditsa (Greece) Year 2003, 25% Irrigation



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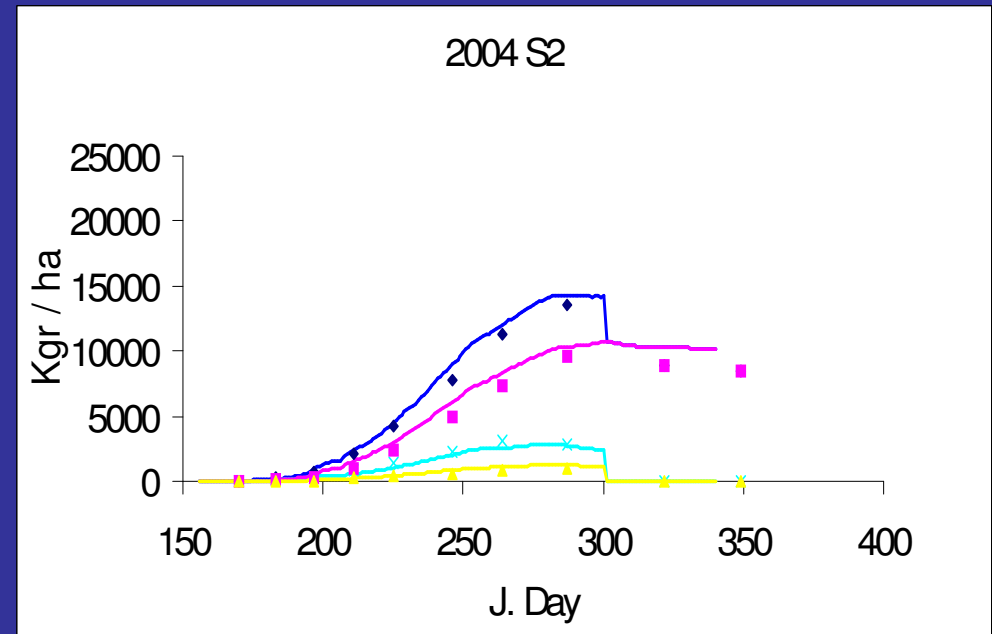
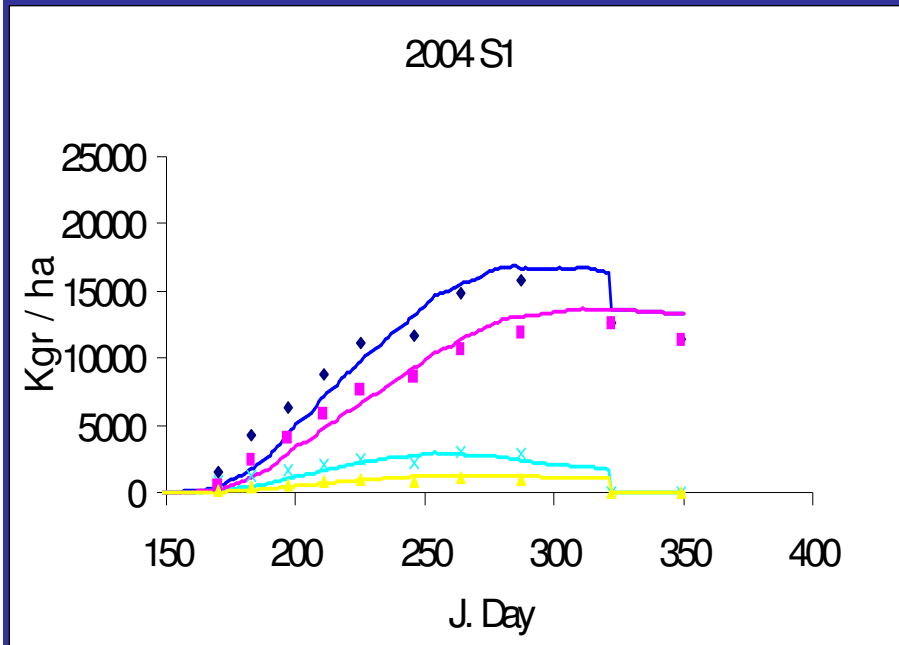
Italy Bologna Year 2003, potential productivity



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Results



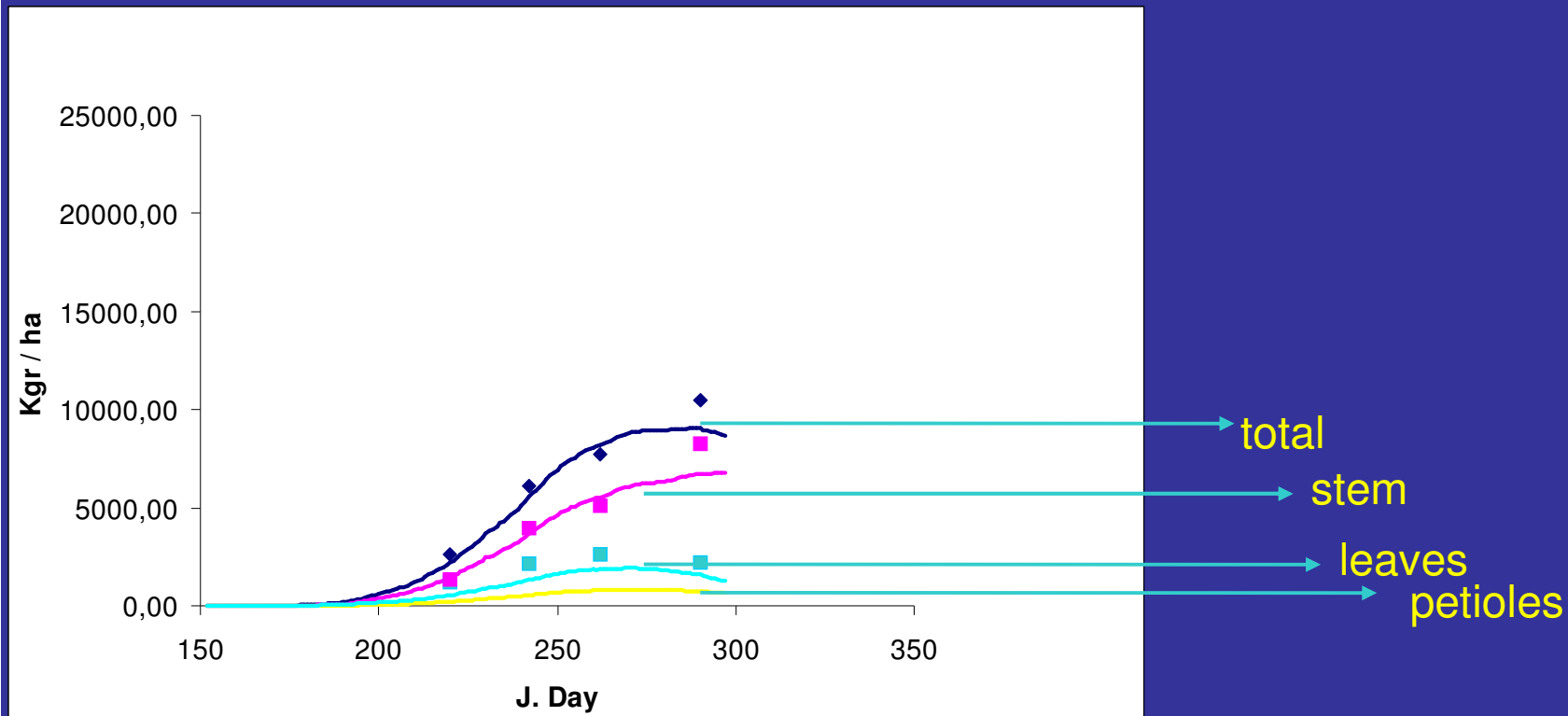
Italy Bologna Year 2004, potential productivity



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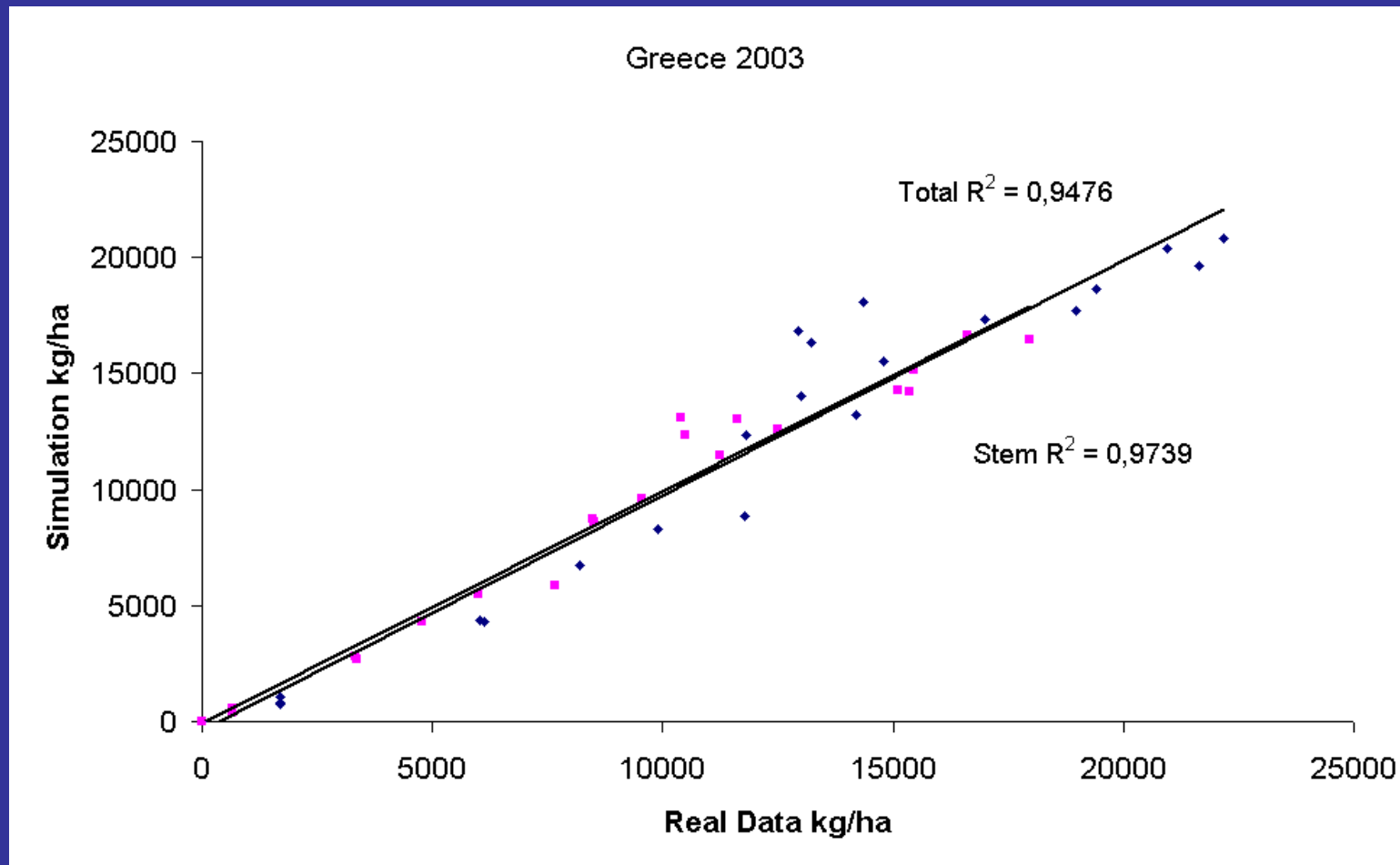
France- Nicae Year 2005, potential productivity



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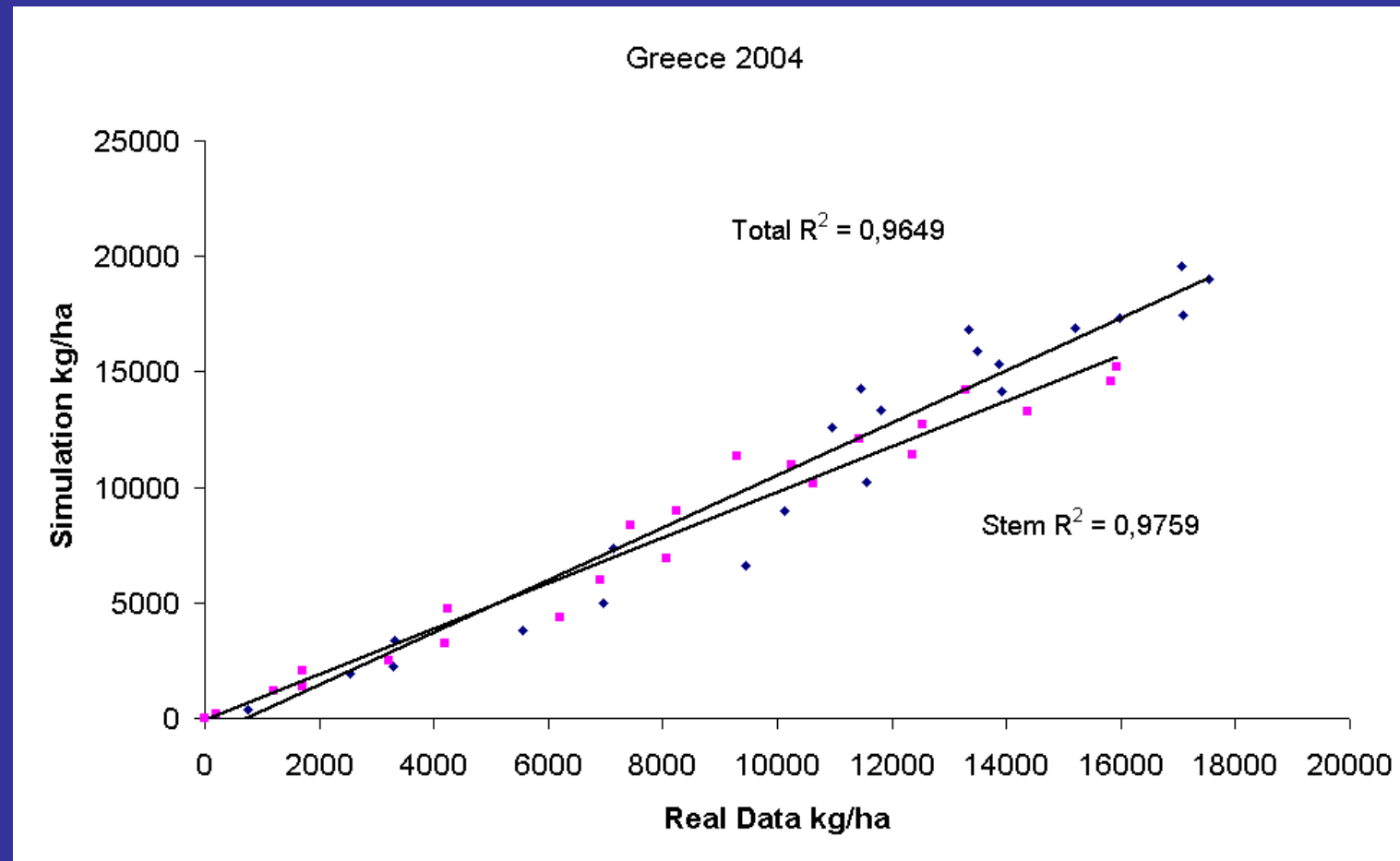
Greece Year 2003



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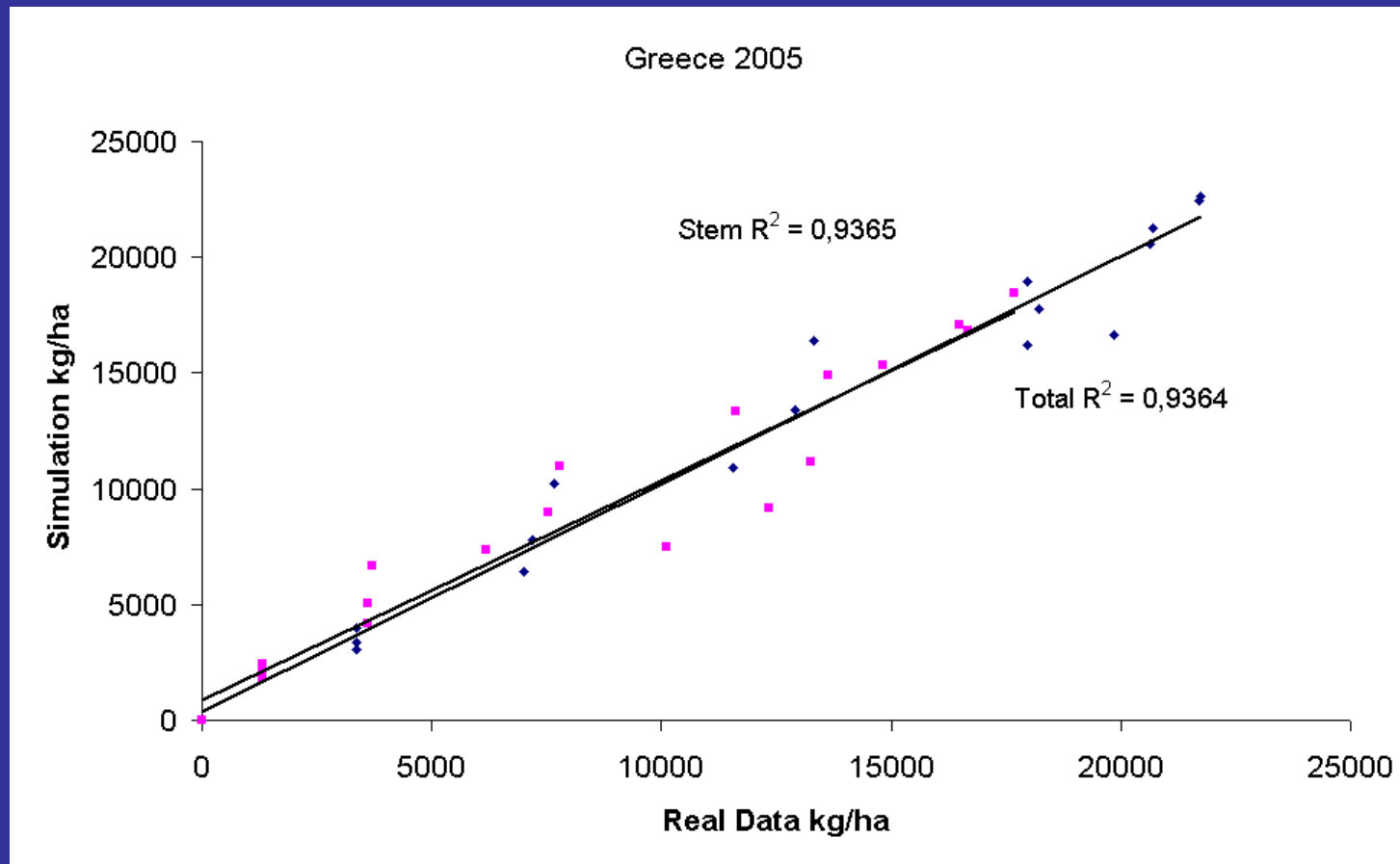
Greece Year 2004



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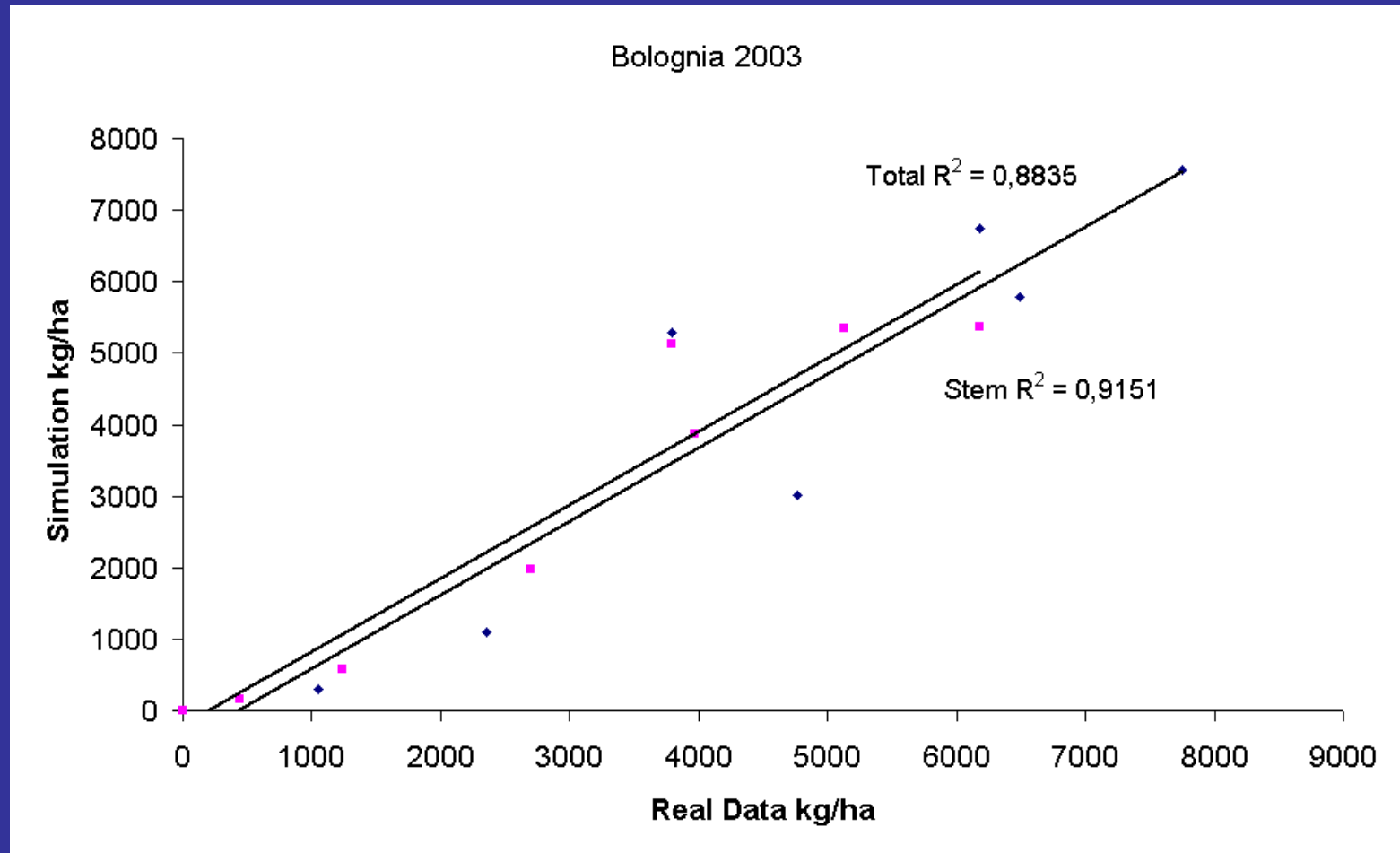
Greece Year 2005



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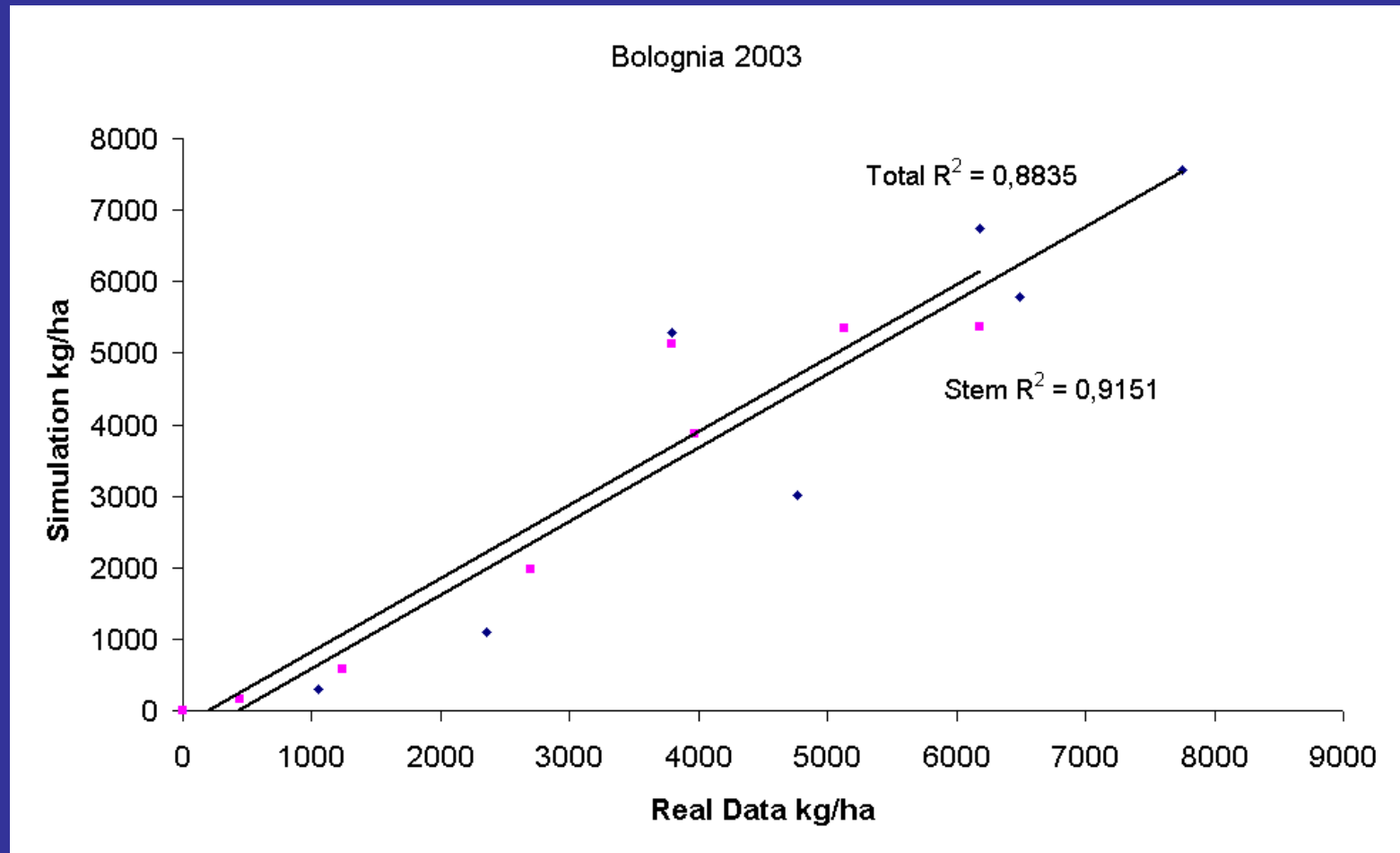
Bologna Year 2003



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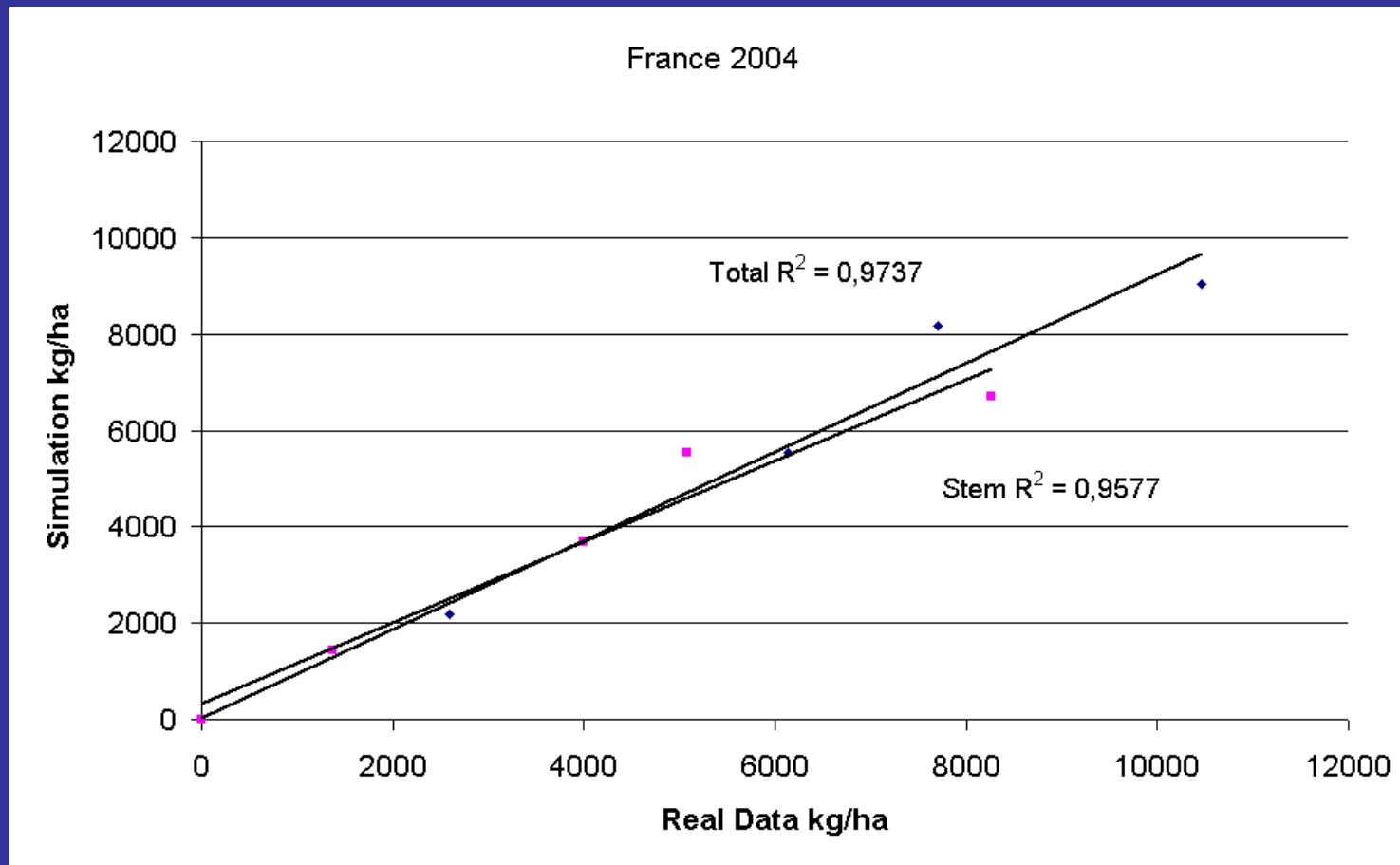
Bologna Year 2003



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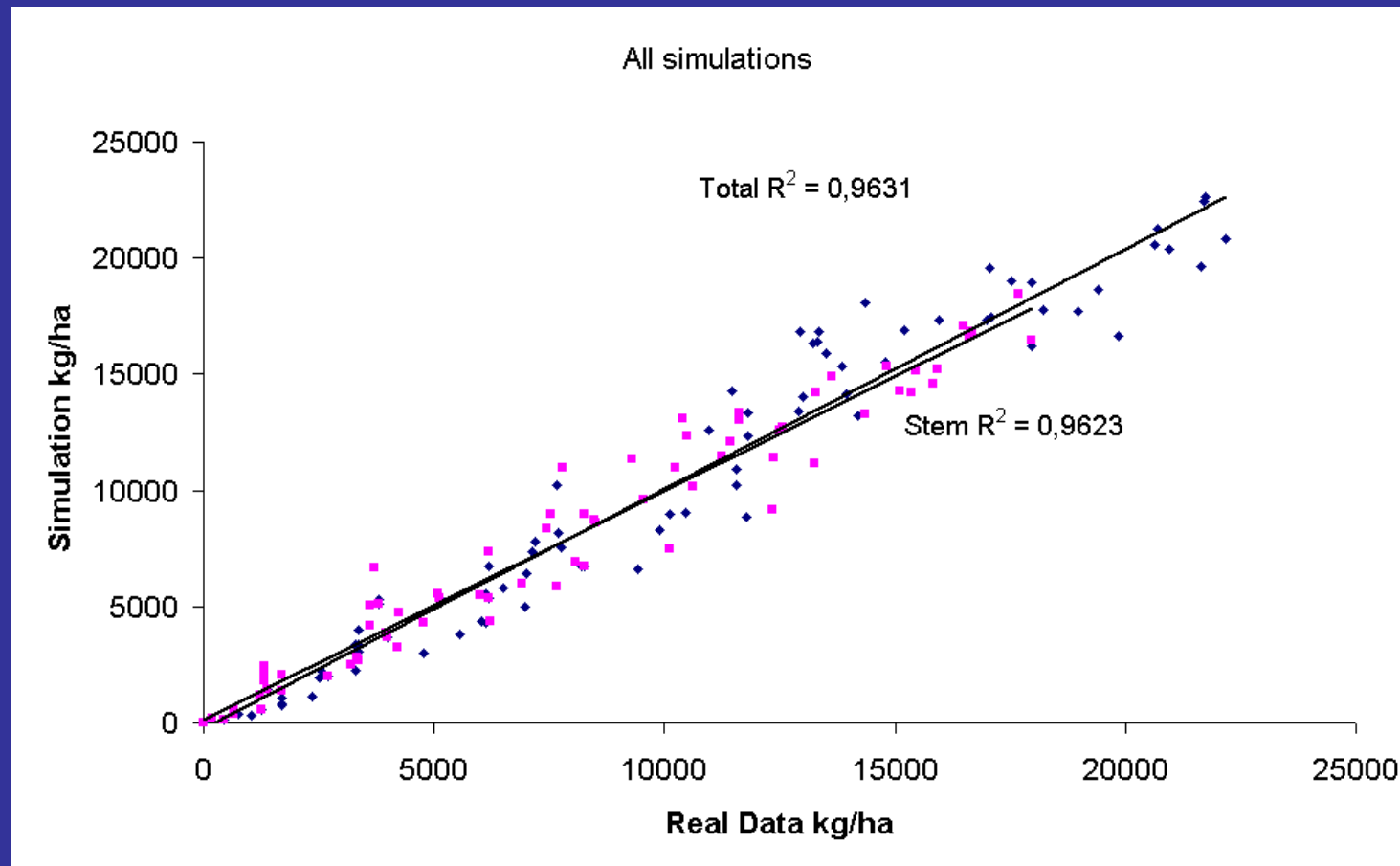
France Year 2004



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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



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Thank you for your attention !



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