CO_2 GAS EXCHANGE PARAMETERS AS THE MEASURE OF BIOMASS PRODUCTION OF THE HUNGARIAN ENERGY GRASS

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Aims and scopes

CO_2 gas exchange characteristics of the Hungarian energy grass will be discussed as the potentialities of biomass production

abiotic environmental factors will be evaluate according to potential carbon-dioxide consumpsion

net photosynthetic rate will be analysed by daily changes to abiotic conditions and light-assimilation curves for the phenophases

assimilation capacity will be calculated and compared to several C3 and C4 grasses and other energy crops

Hungarian energy grass

Tall wheatgrass (*Elymus elongatus* subsp. *ponticus)* cultivar „Szarvasi-1” energy grass

Alternative biomass plant for agronomic and energetic purposes

perennial bunchgrass
2-3 m tall, erect shoot
narrow, strongly ribbed leaves
C3 photosynthetic pathway
5 vegetative phenophases until flowering

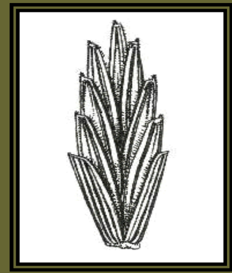
Material and method I.

- Plant material from South-Hungary
- Experimental field and growing pots
- Different environmental conditions

	Experimental field	Growing pot
Altitude (m)	130	190
Soil type	cambisol	cambisol
Soil pH (H_2O)	6,92 ± 0,63	6,92 ± 0,63
Humus content (m/m %)	1,76 ± 0,20	1,76 ± 0,20
$CaCO_3$ (m/m %)	0,84 ± 1,48	0,84 ± 1,48
Ca (mg/kg)	7156,97 ± 4297.72	7156,97 ± 4297,72
K (K_2O) mg/kg	266,19 ± 76,69	266,19 ± 76,69
NO_2+NO_3 (mgN/kg)	40,11 ± 9,47	40,11 ± 9,47
PAR (µmol m^{-2} s^{-1}) (min-max)	62-1521	16-2999
Environmental CO_2 (ppm) (min-max)	105-441	315-456
Relative air humidity (RH %) (min-max)	13,8-64,9	2,8-15,6
Leaf temperature (T_leaf C^o) (min-max)	16,6-28,4	15,8-36,8

On nutrient rich brown soil type

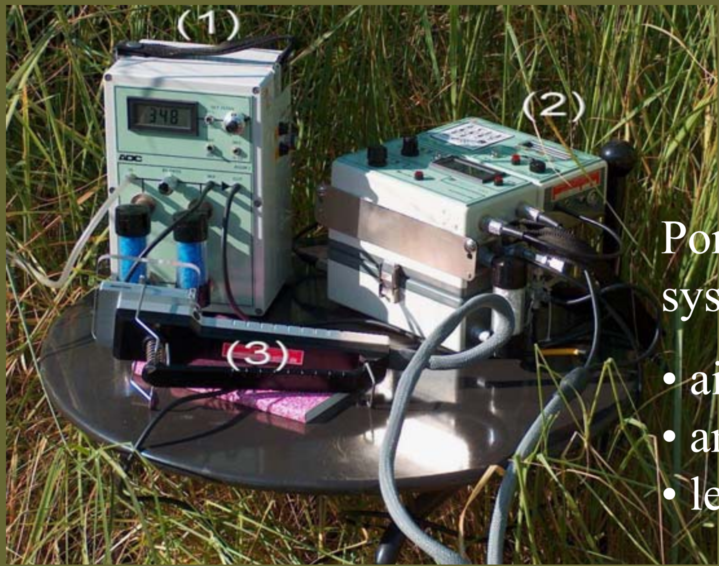
Material and method II.



Leaf gas exchange parameters by IRGA gas analyser
Data measuring on the flag leaf in four phenophases

net assimilation rate (A_n, µmol m^{-2} s^{-1})
assimilation capacity (A_{max}, µmol m^{-2} s^{-1})
stomatal conductance for CO_2 (g_s, mmol m^{-2} s^{-1})

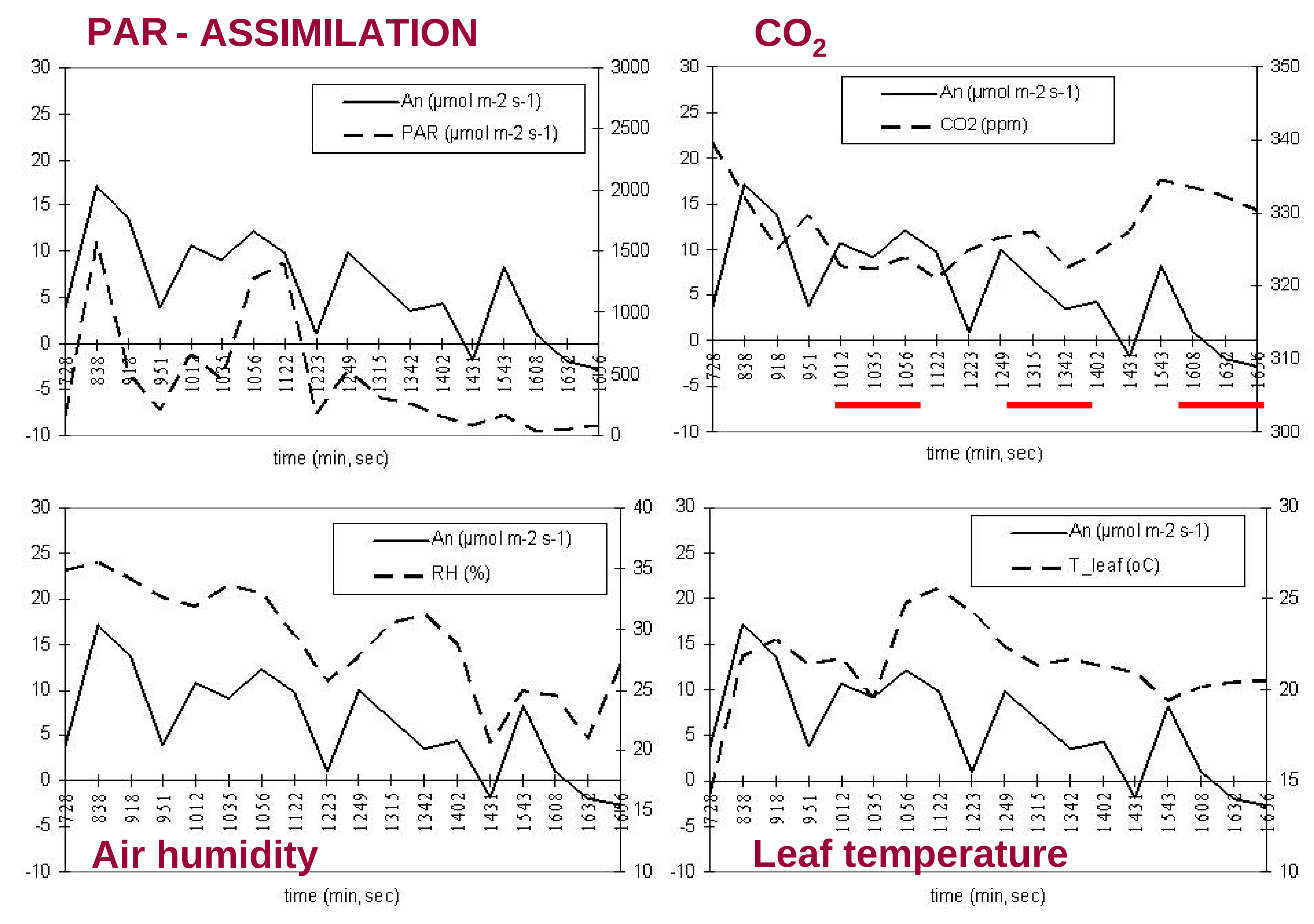
in situ measuring



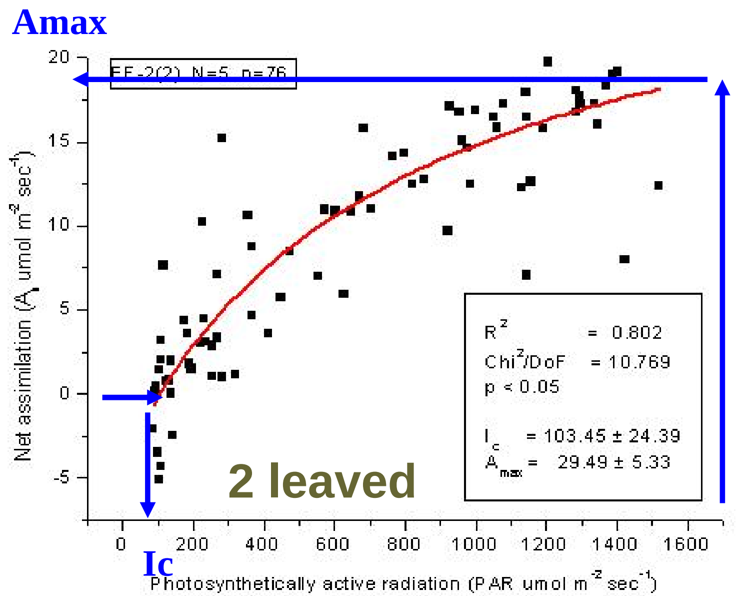
Portable steady-state IRGA system (ADC, UK)

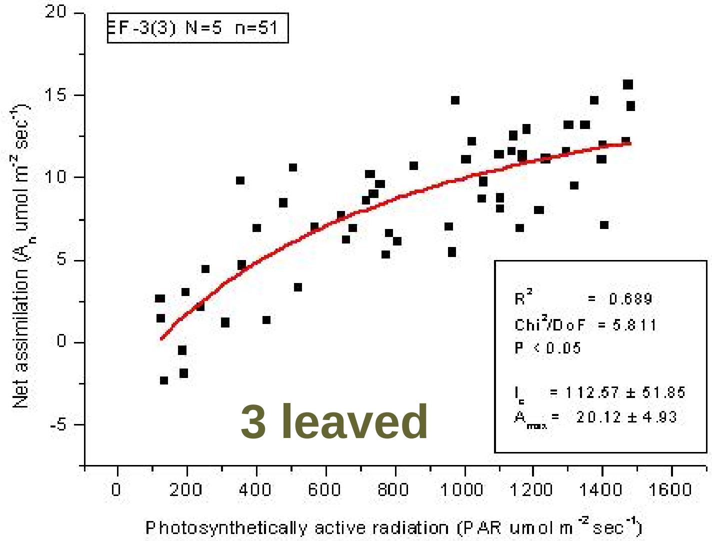
- air supply unit (1)
- analyser and data logger (2)
- leaf chamber (3)

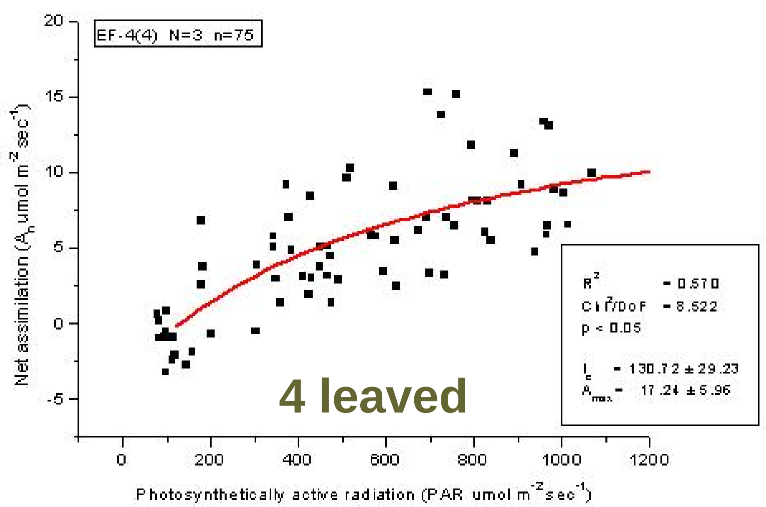
Results I. Daily course of assimilation

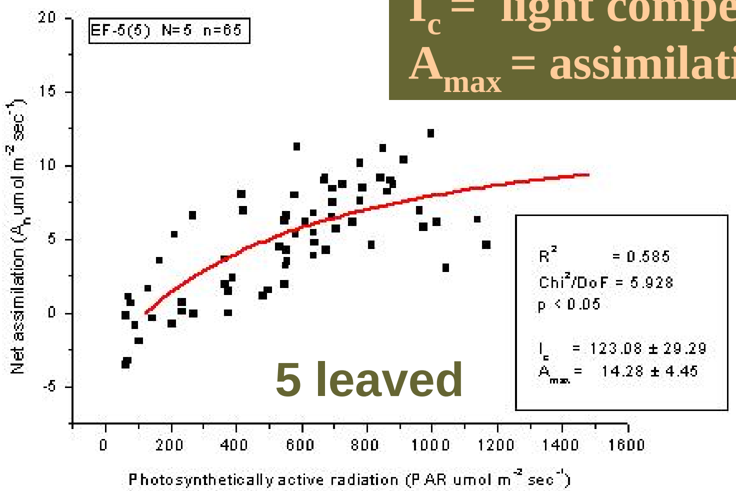


Results II.
Light-assimilation in experimental field



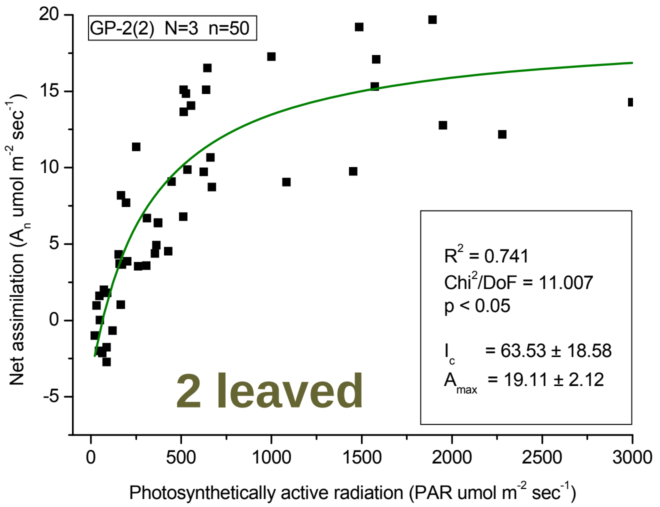


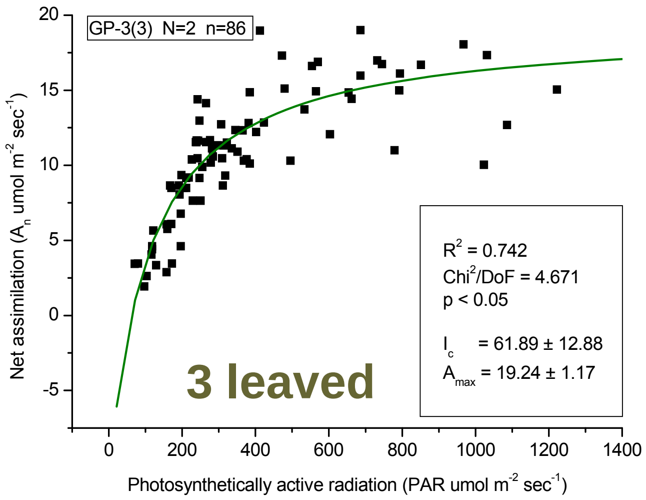




I_c = light compensation point
A_{max} = assimilation capacity

Results III.
Light-assimilation in growing pots





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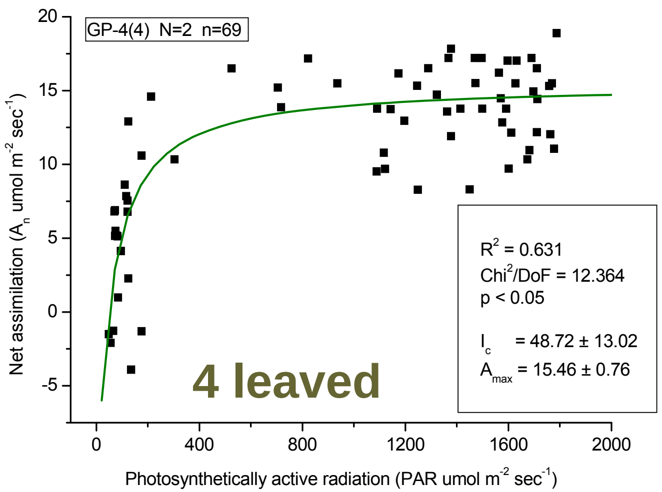
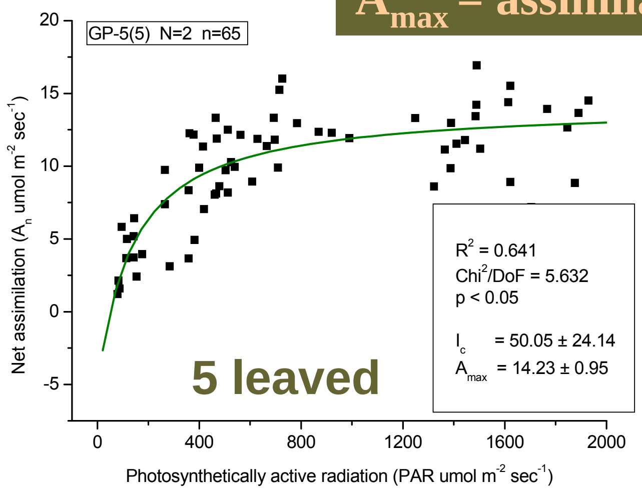
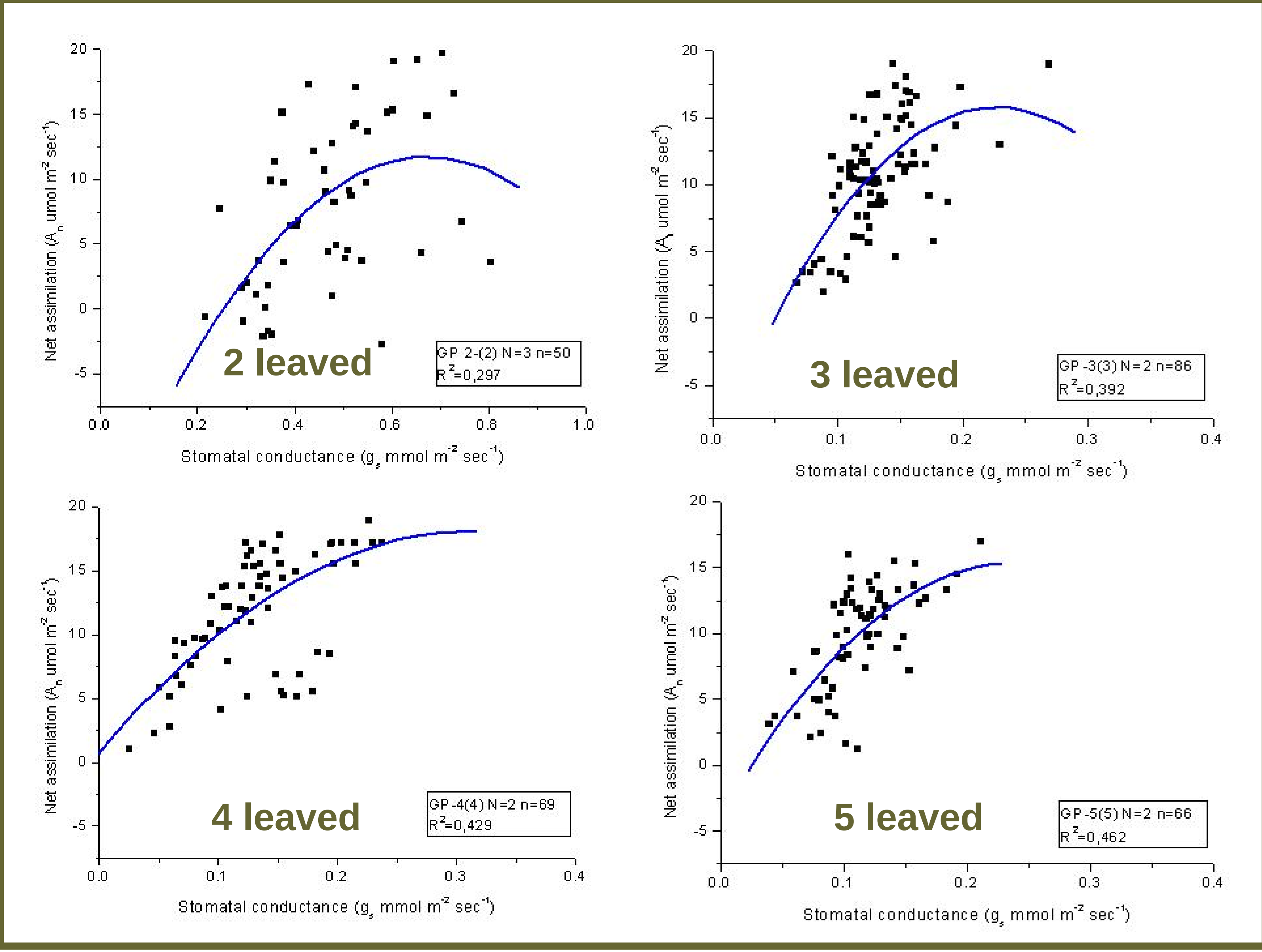
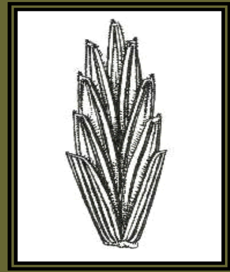




Results IV.
CO_2 conductance in the phenophases





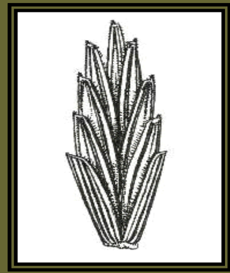
Growing pots:
0,05-0,8 mmol

Experimental field:
0,05-0,35 mmol

Results V.
Assimilation capacity of crops and trees

	common name	species name	A_{max} (µmol m^{-2} s^{-1})
C4 crops	Maize (Turkish wheat)	Zea mays	35-40
	Redroot amaranth	Amaranthus retroflexus	40-50
	Thornapple	Datura stramonium	50-60
	Giant Silver Grass	Miscanthus × giganteus	35-40
C3 crops	Couch-grass	Agropyron repens	5-10
	Hungarian energy grass	Elymus elongatus cv.	14-30
	Switchgrass	Panicum virgatum	8-10
	Wheat	Triticum aestivum	45
	Rice	Oryza sativa	40
C3 trees	Black locust	Robinia pseudo-acacia	30
	Poplar species	Populus spp.	20-25
	Willow species	Salix spp.	20-35

Conclusions



selected remarkable values of leaf assimilation (I_c, g_s, A_{max}) are appropriate tools for estimating Hungarian energy grass to be a carbon-dioxide sink

light-assimilation curves from two different localities revealed that assimilation rate must be greater under extreme field conditions (high light and air humidity) on normal CO_2 level

regulatory function of ***stomatal conductance*** in carbon fixation become more significant as a reduction factor in assimilation under low air humidity through the phenophases

Hungarian („Szarvasi-1") energy grass has a ***moderate assimilation rate*** among C3 plant species in the initial stage of its life cycle

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Thank you for attention !