Potassium as a tool to ameliorate drought impact on plant crops

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Scientific bacground

Part I

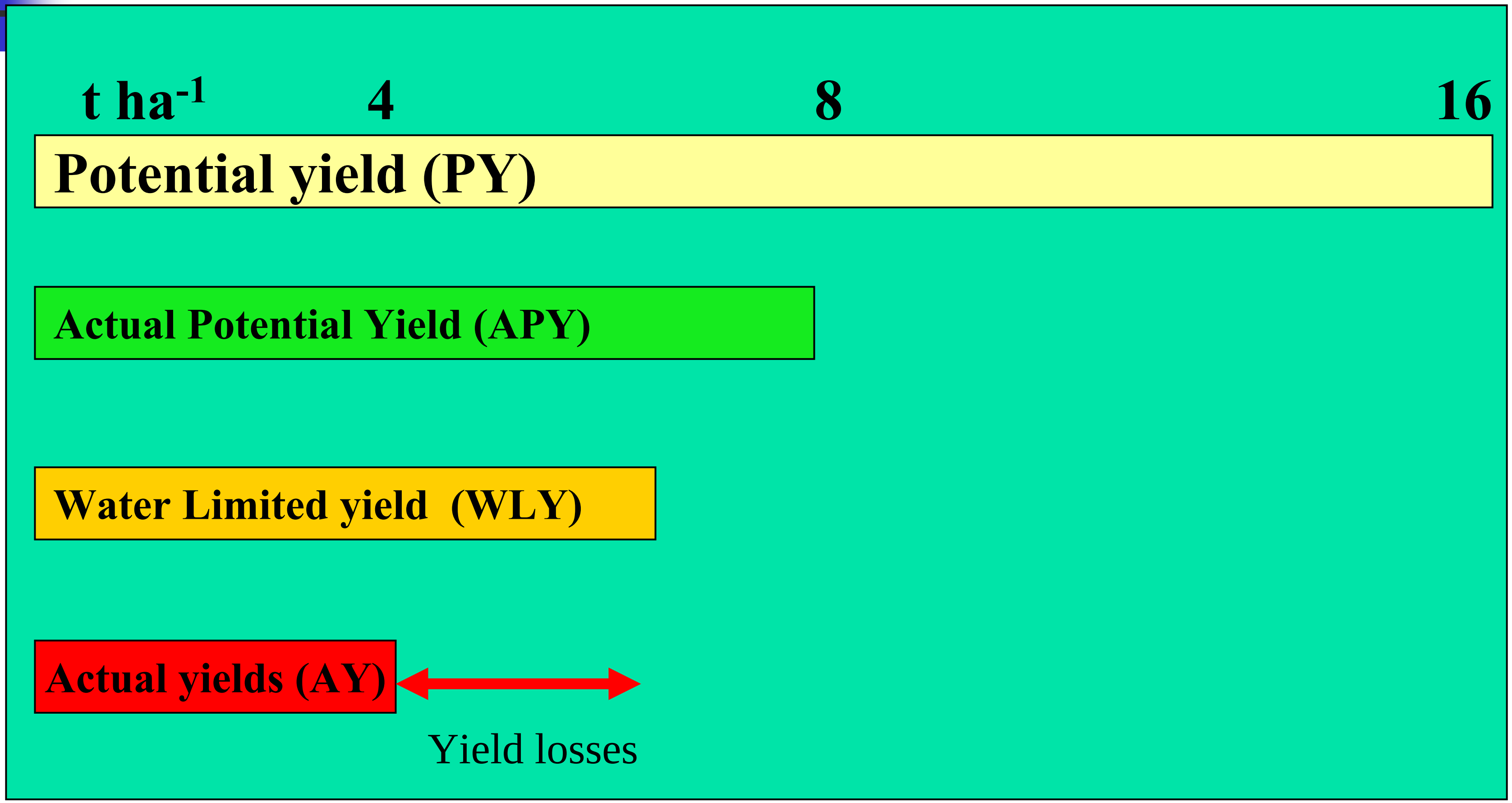
Eco-physiological characteristics of yielding factors

I. **Defining yield:**
1. Plant factors:
   1. Physiology, phenology;
   2. Plant breeding - covarieties;
   3. conopy architecture;
2. Radiation;
3. CO_2
4. Temperature;

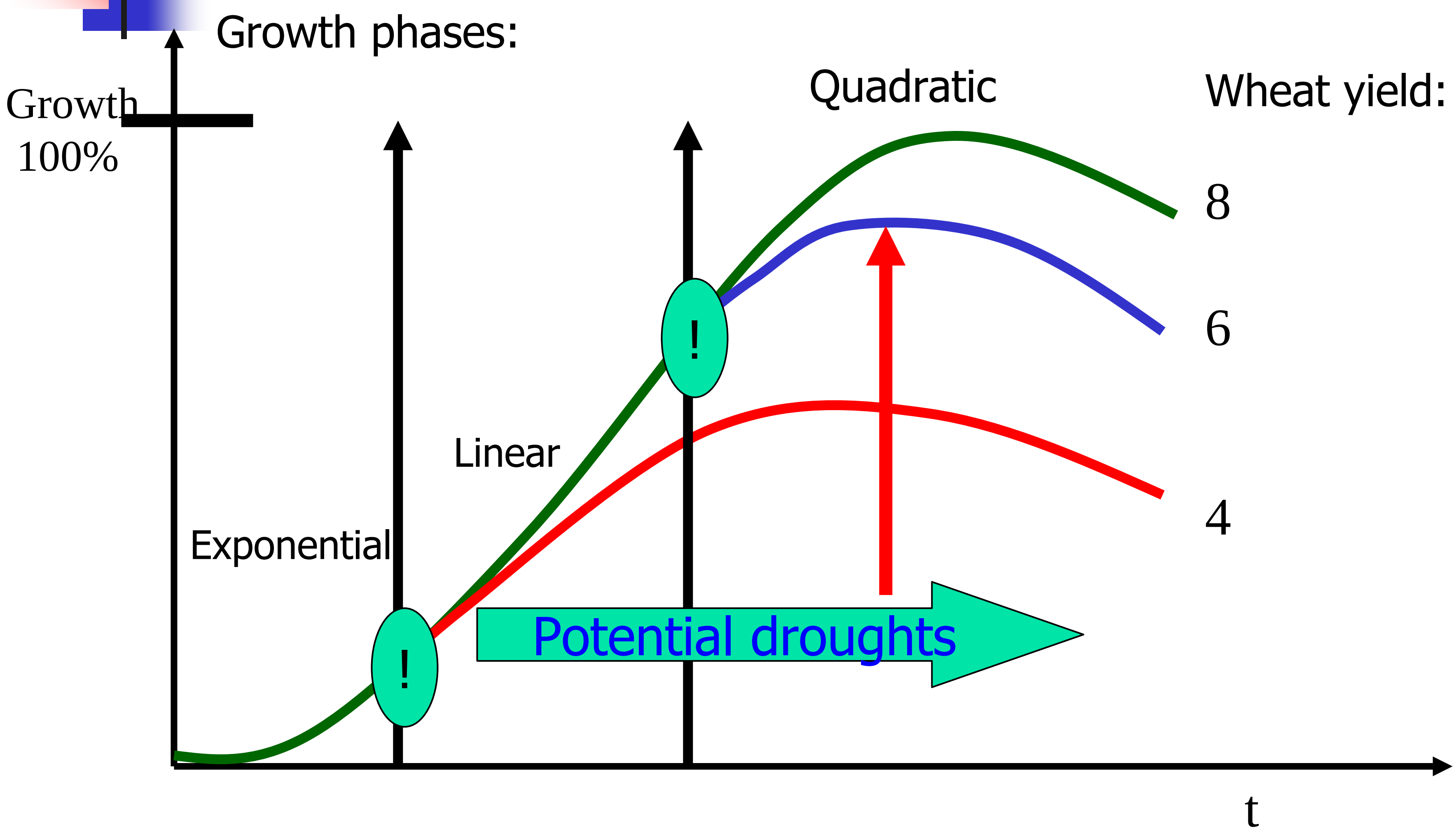
II. **Factors limiting yield:**
1. water,
2. Soil :
   1. Soil reaction,
   2. Soil fertlity;

III. **Factors limiting yields:**
1. Weeds;
2. Pathogens;
3. Enviroment pollution.

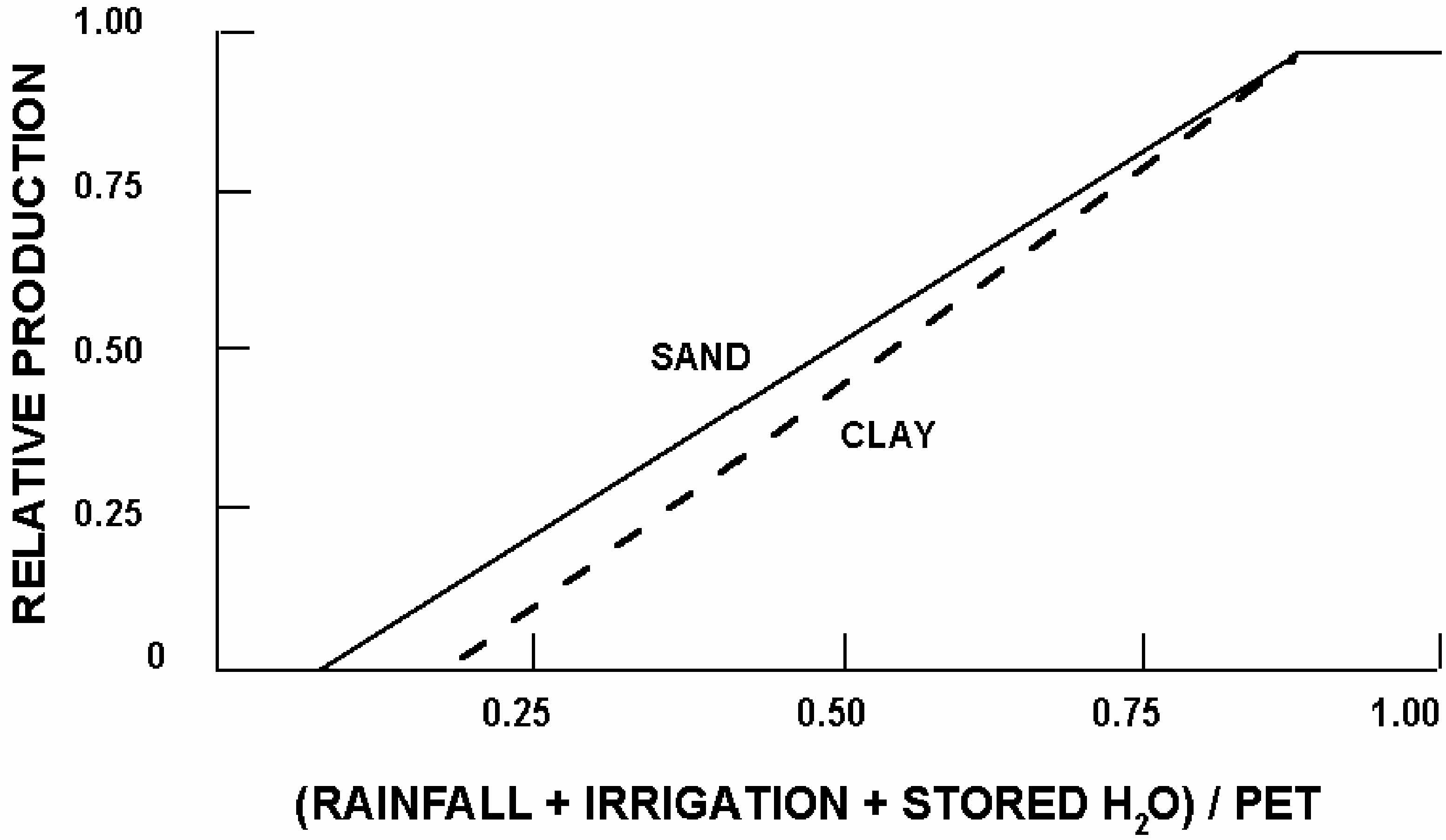
Yield categorisation, the case of winter wheat (Poland)



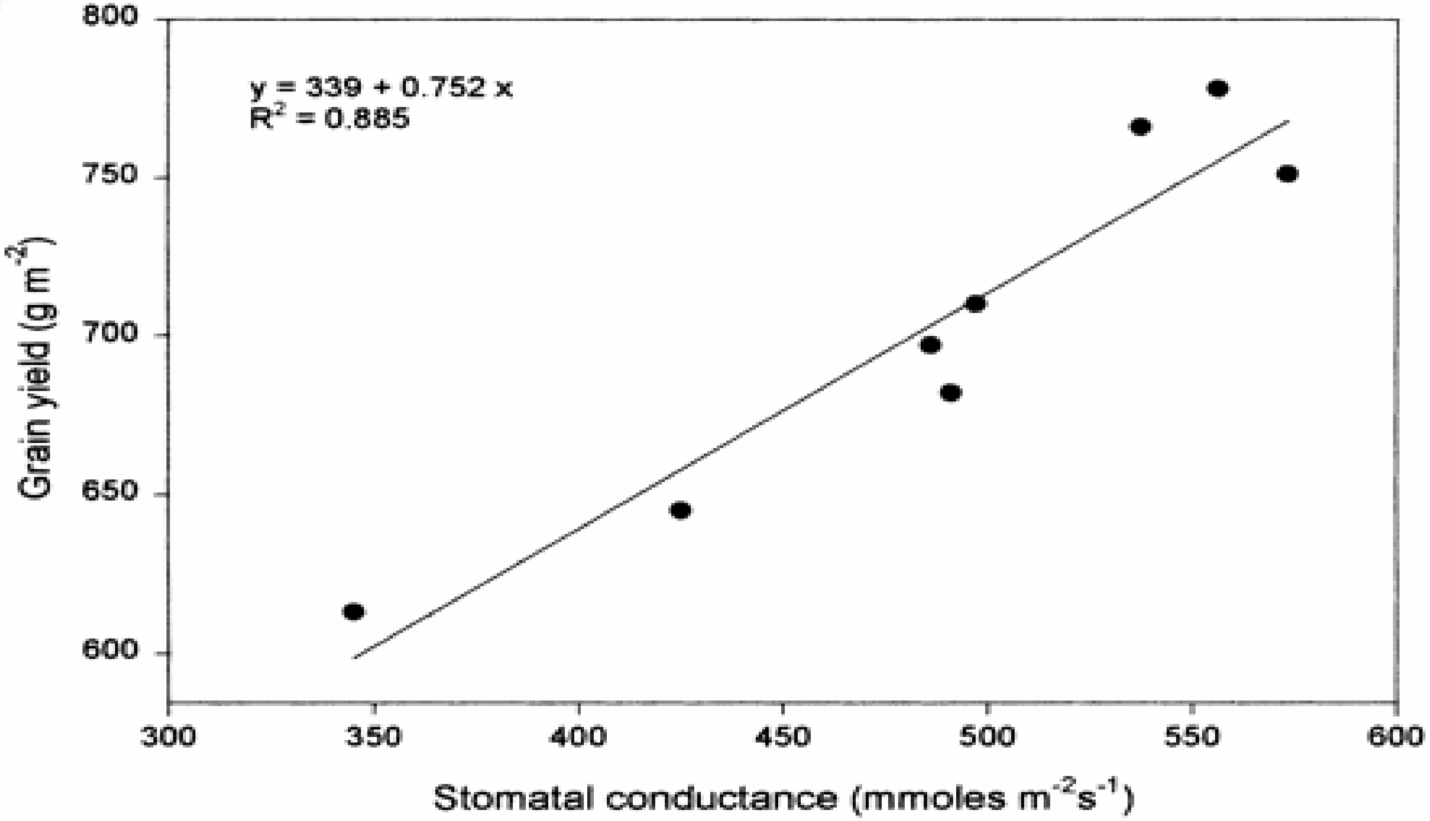
Stress conditions *versus* growth and yield of a crop plant - winter wheat



Dry matter production as a function of water availability

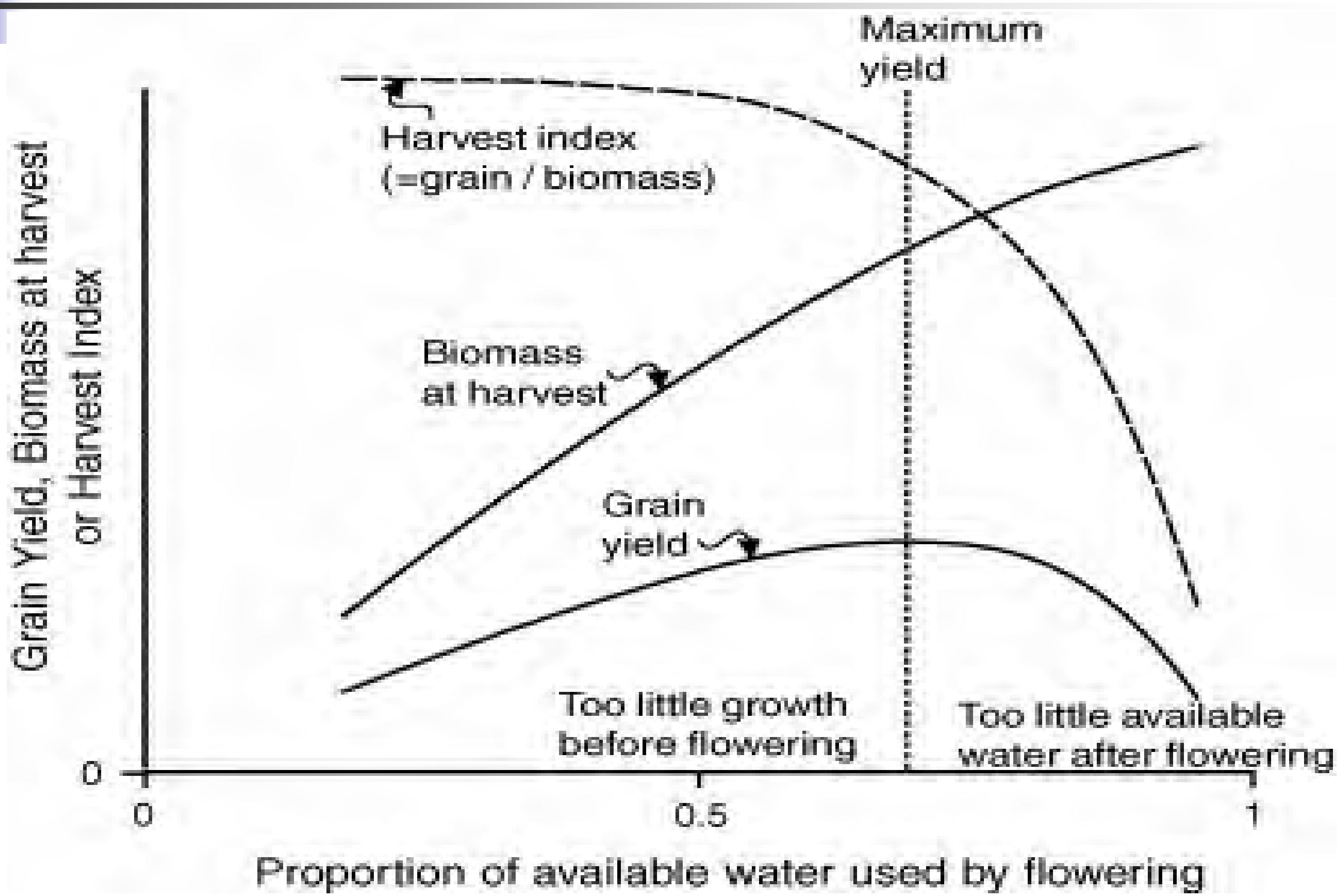


Grain yield as function of stomatal conductance



Sayree et al.., 1997

Cereals yield and characteristics as affected by water availability

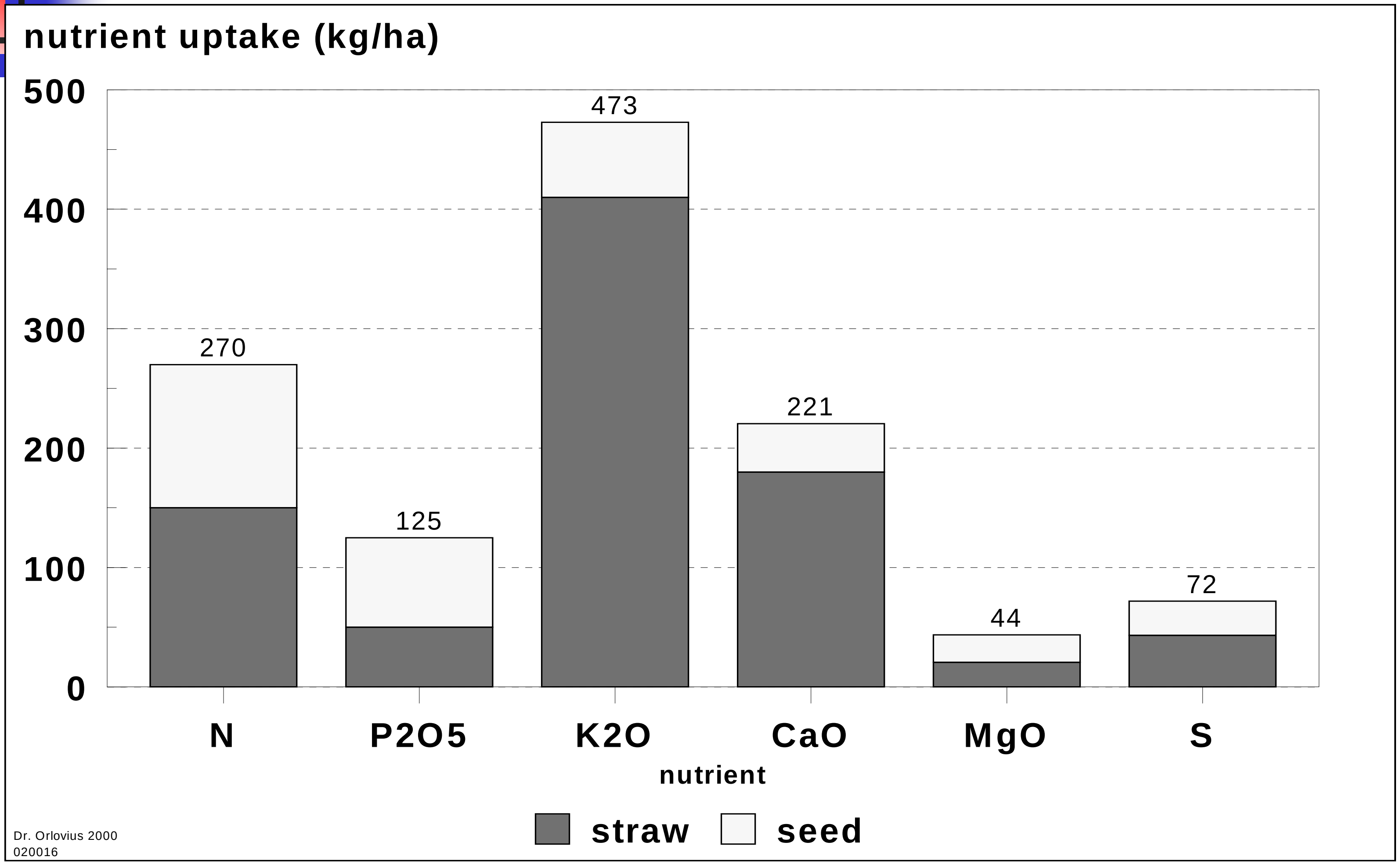


Passioura. 2006

Potassium yielding functions - experimenta data

Part II

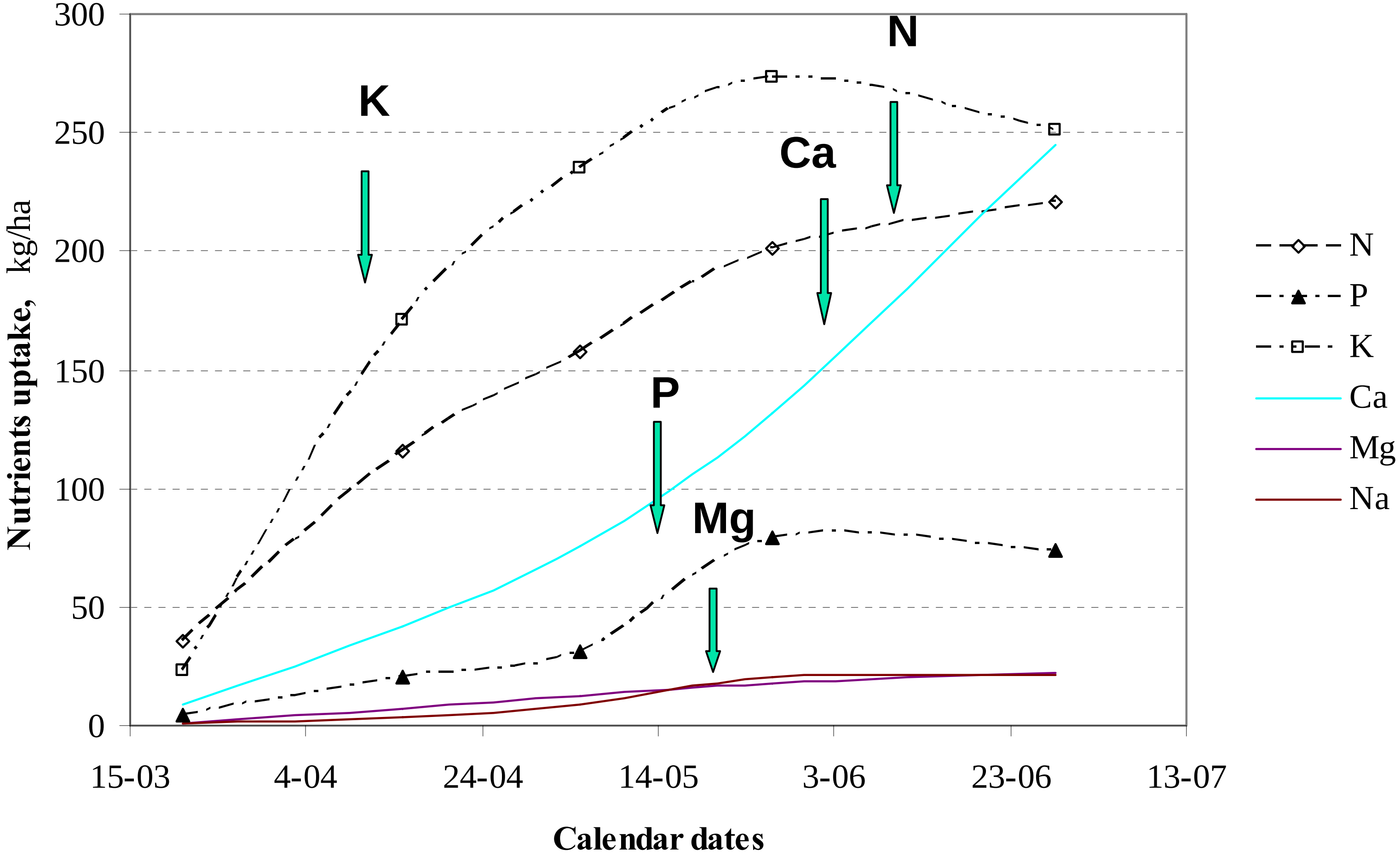
Plant nutritional needs: as example - final nutrients uptake by oilseed rape



Yield, 4,0 t/ha

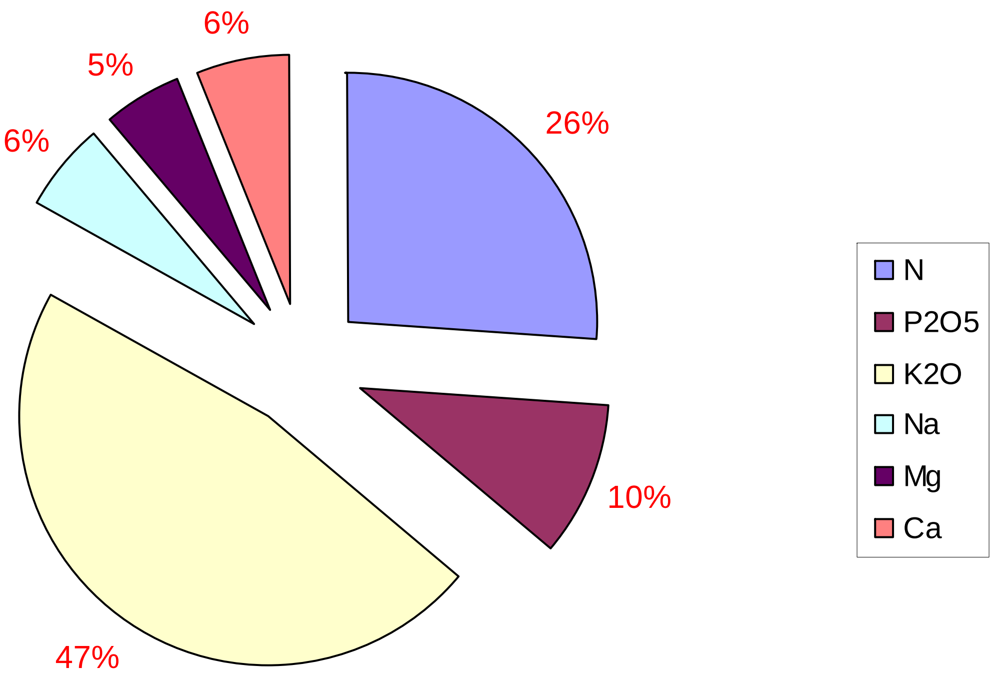
Orlovius, 2000

Dynamics of nutrients uptake (accumulation) by oilseed rape



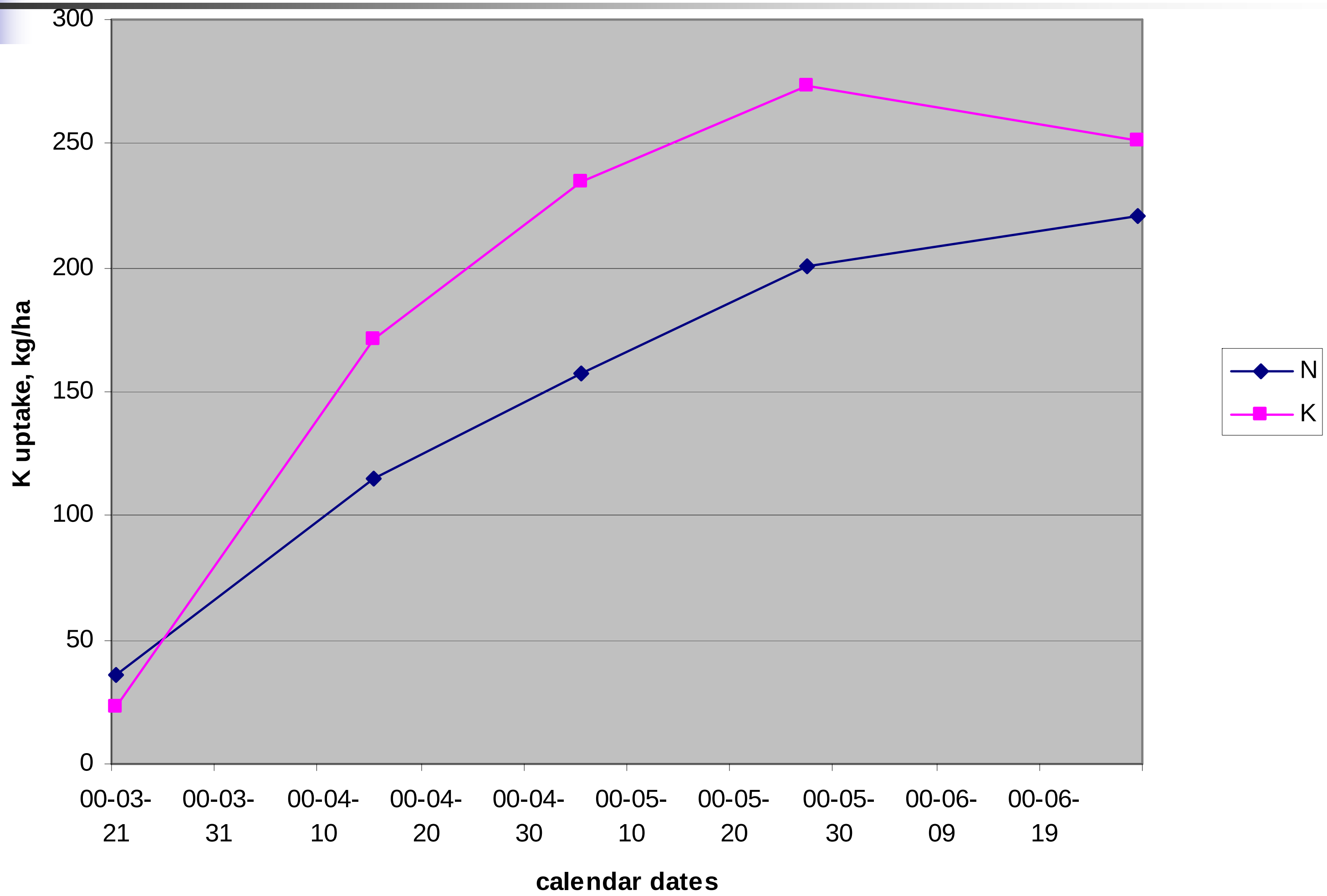
Grzebisz, Barłóg, 2005

Structure of nutrients accumulated in a crop plant at harvest – the case of sugar beets



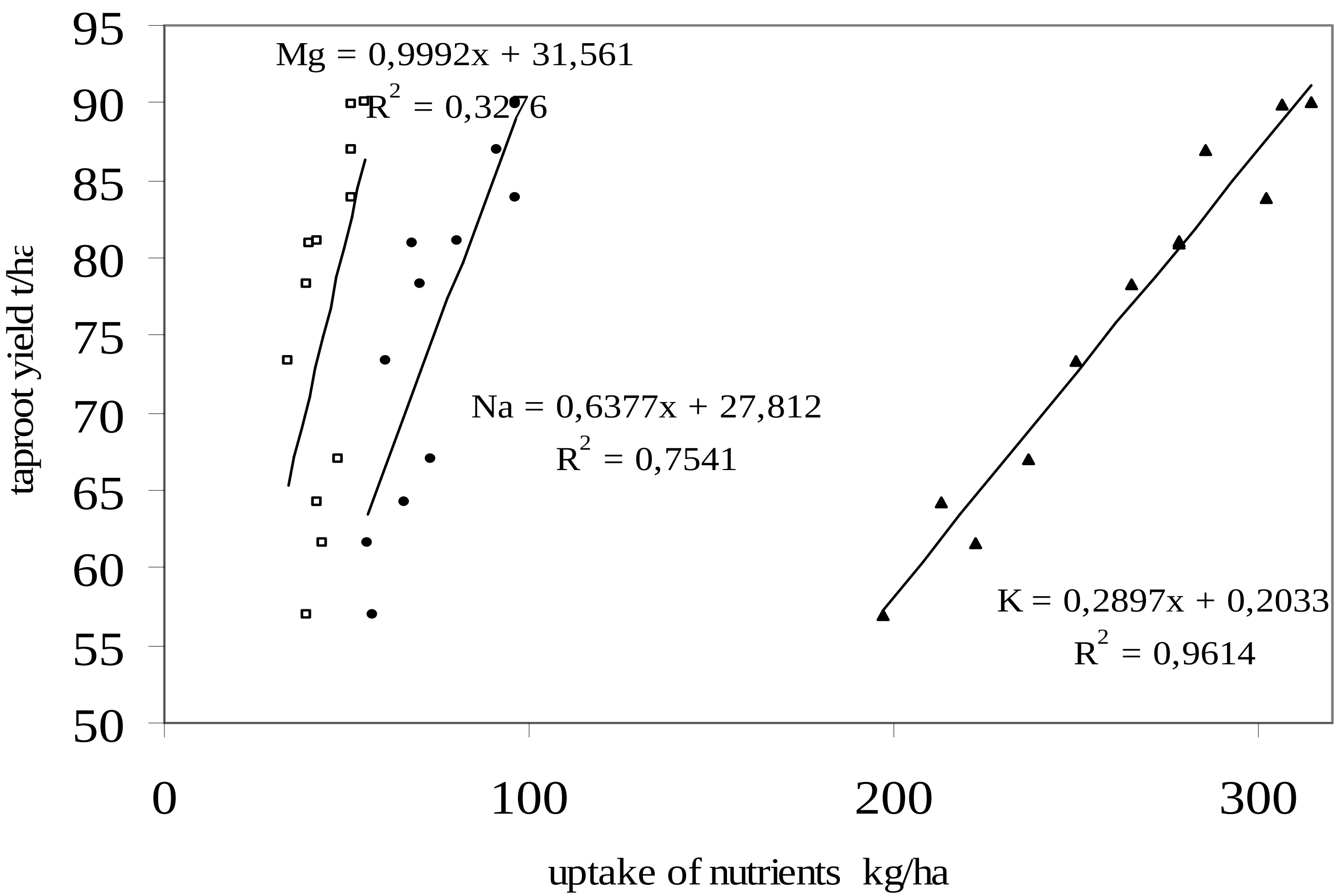
Grzebisz, 2005

Dynamics of N and K accumulation by sugar beets



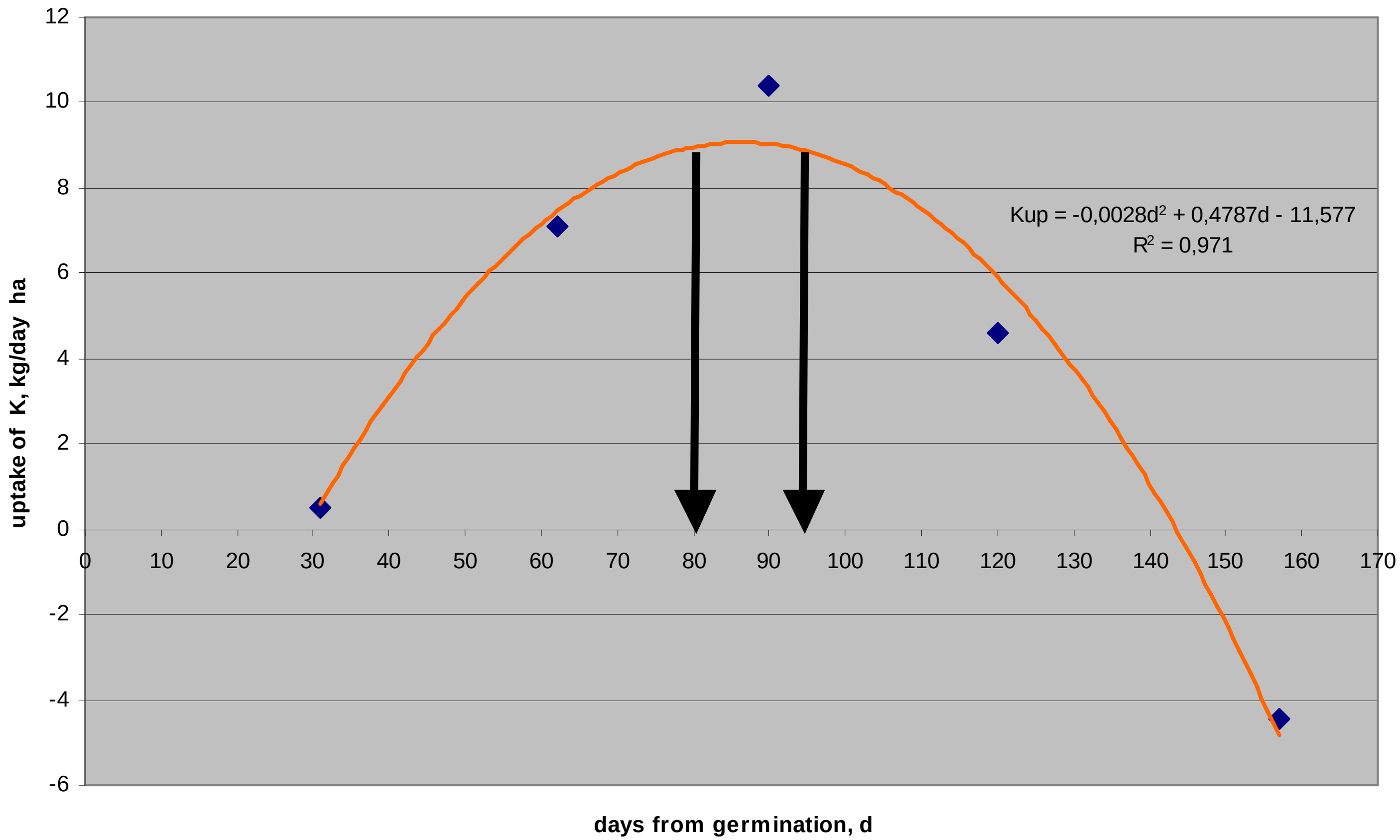
Grzebisz et al.., 1998

Yields of sugar beets as a function of cations uptake



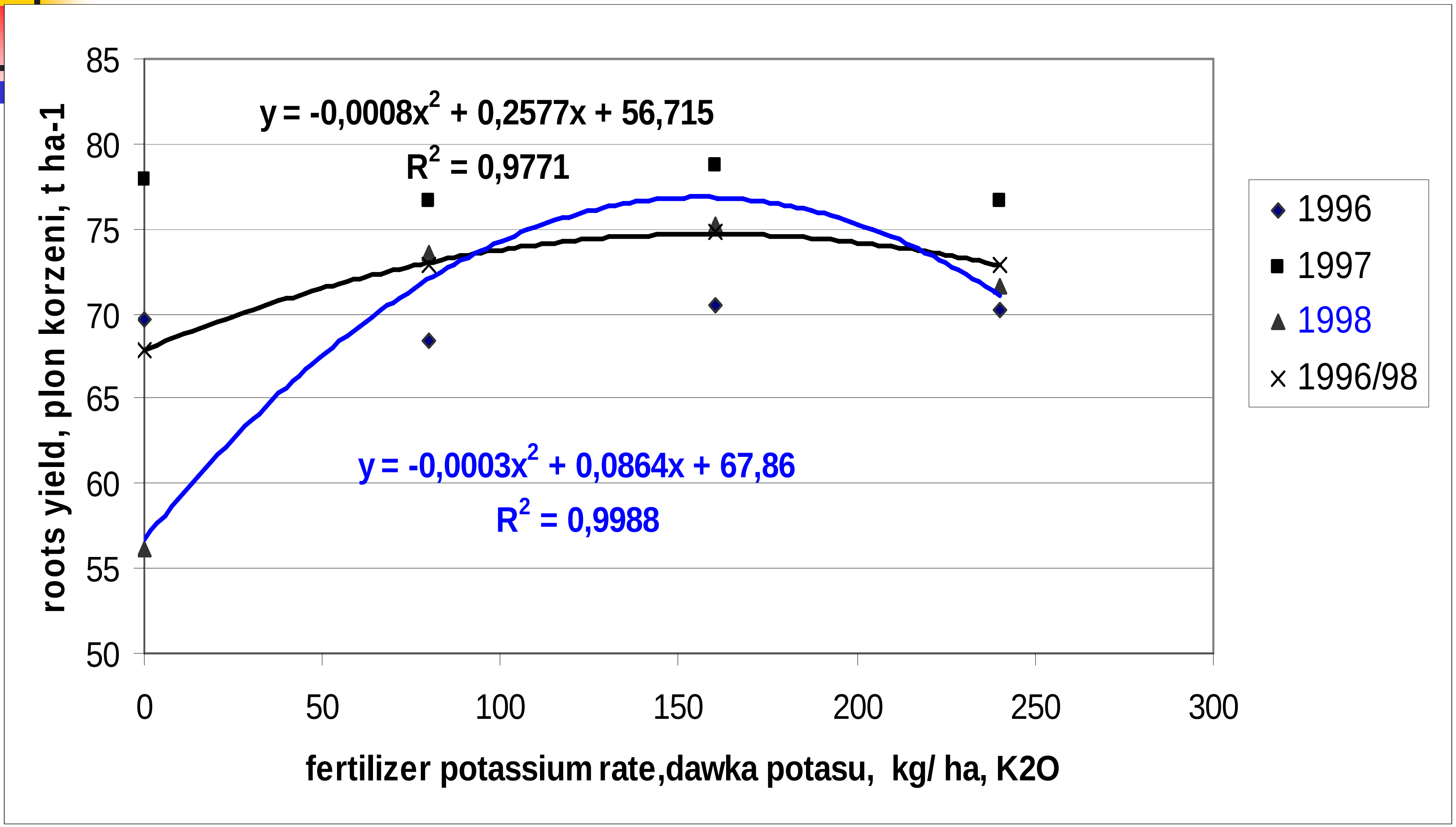
Barłóg et al.., 2000

Potassium uptake rate – the critical stage of sugar beet plants growth



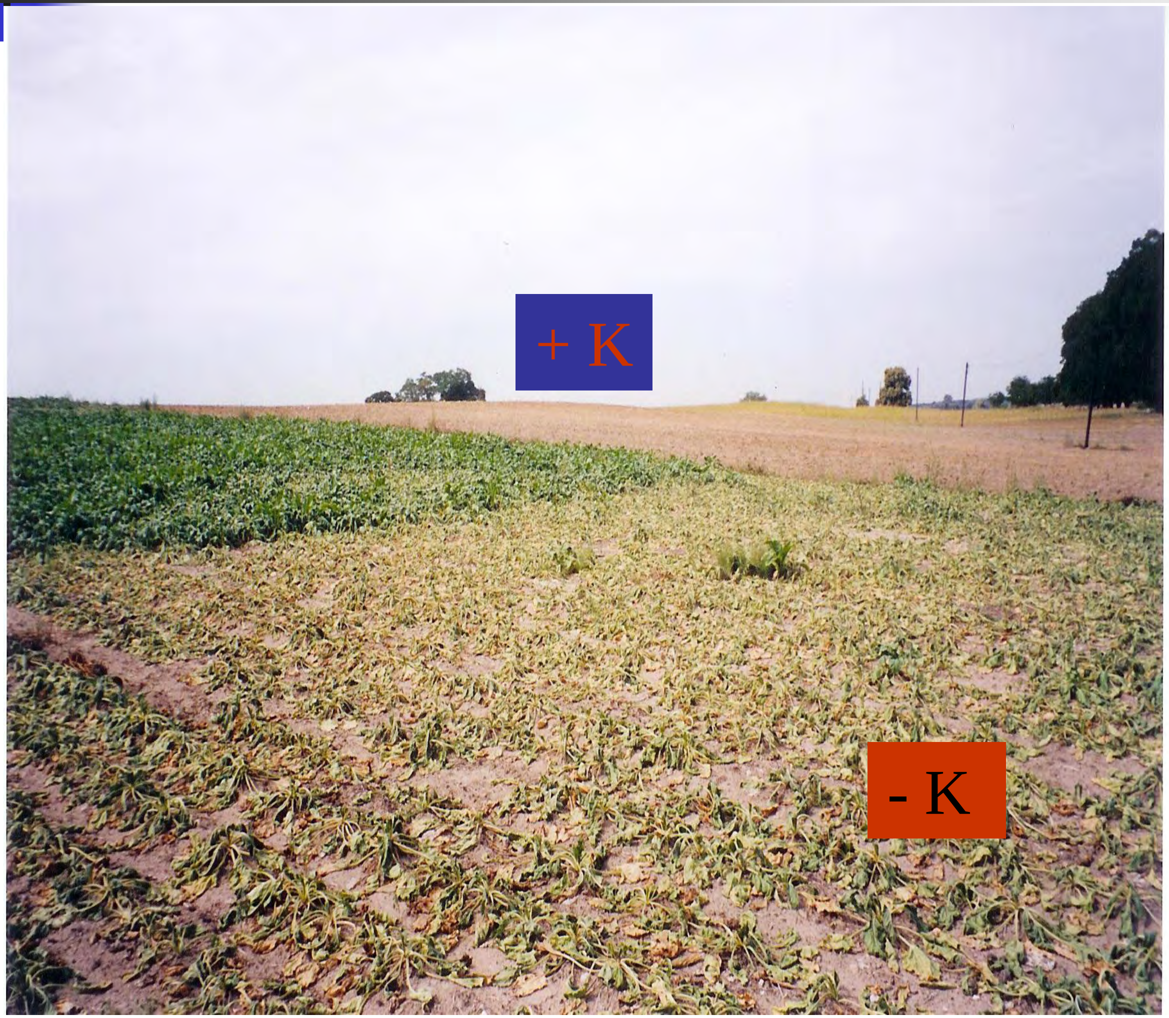
Grzebisz, 2005

Sugar beets response to potassium annual supply



Wojciechowski et al.., 2002

Availability of soil potassium and sugar beets response to water stress



Naskręt

Soil types and impact of drought on maize yield performance *(year2004)*

Soil: sandy clayey

Grzebisz

How to alleviate the impact of drought on crop plants?!

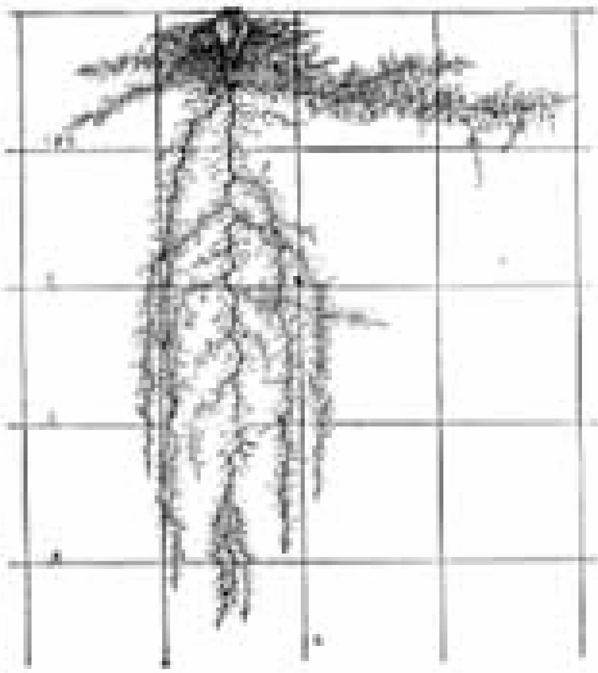
Part III

governing potassium supply

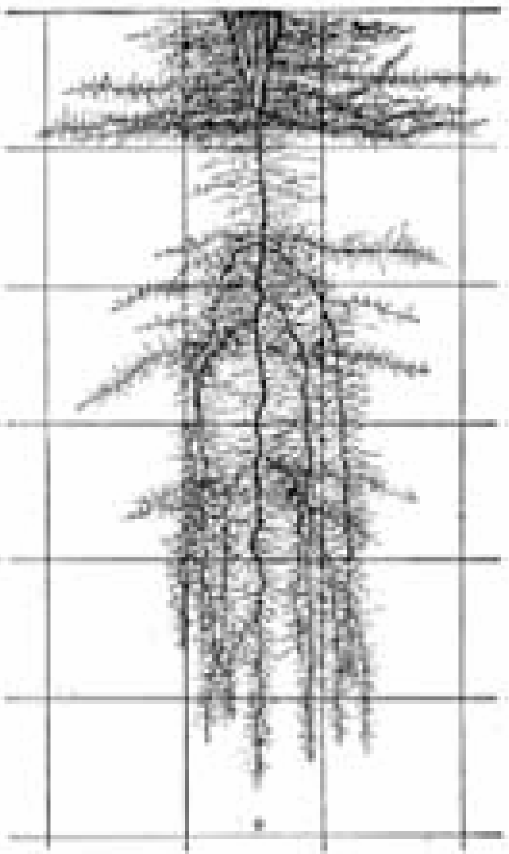
Optimally productive soil

- Contains sufficient water reserve and is able to supply plants, adequately;
- Enables a deep penetration of the crop plant root system;
- Accumulates mineral elements in available forms, and simultaneously protects them against losses.

Root system of sugar beets



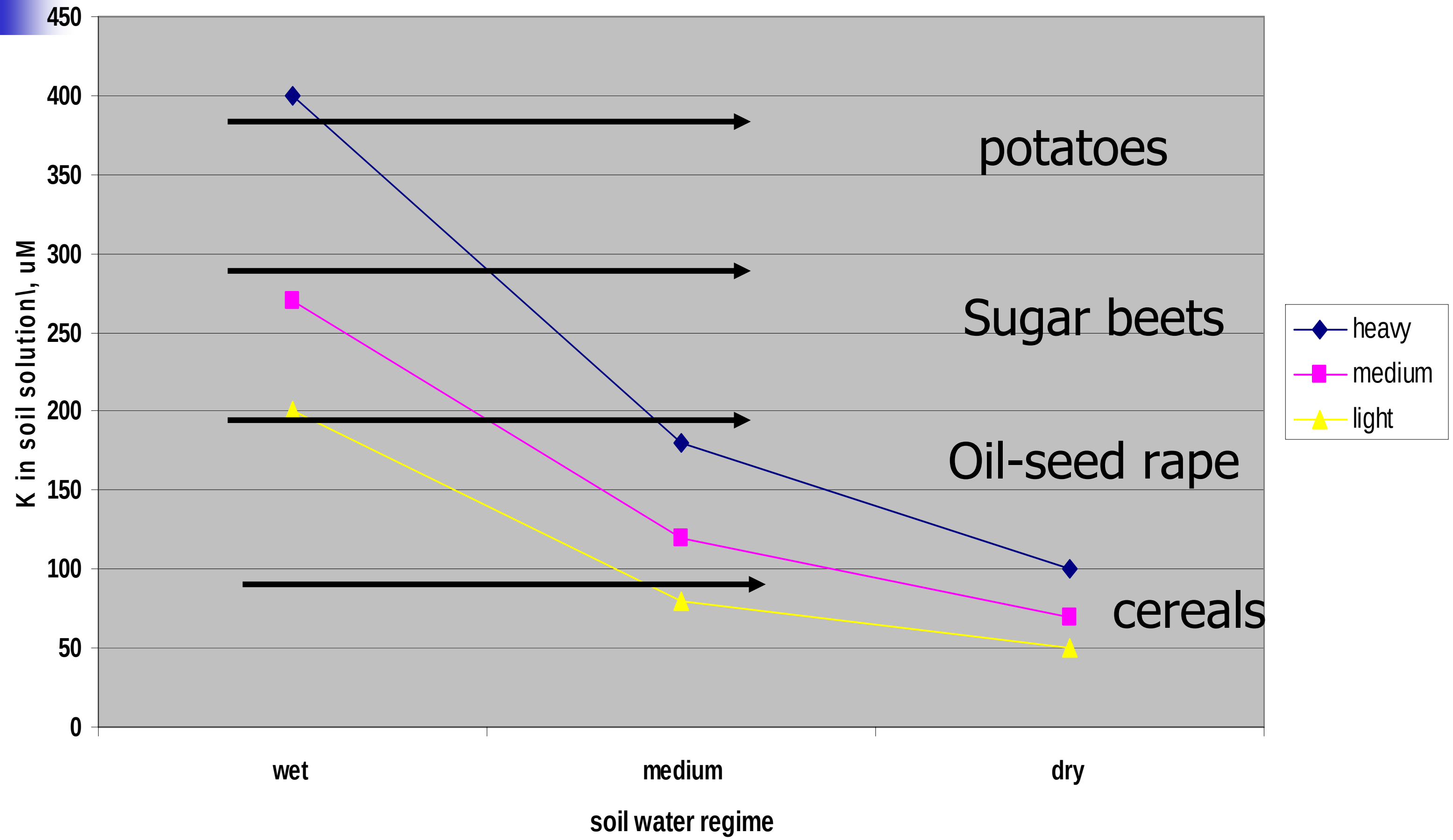
K -



K +

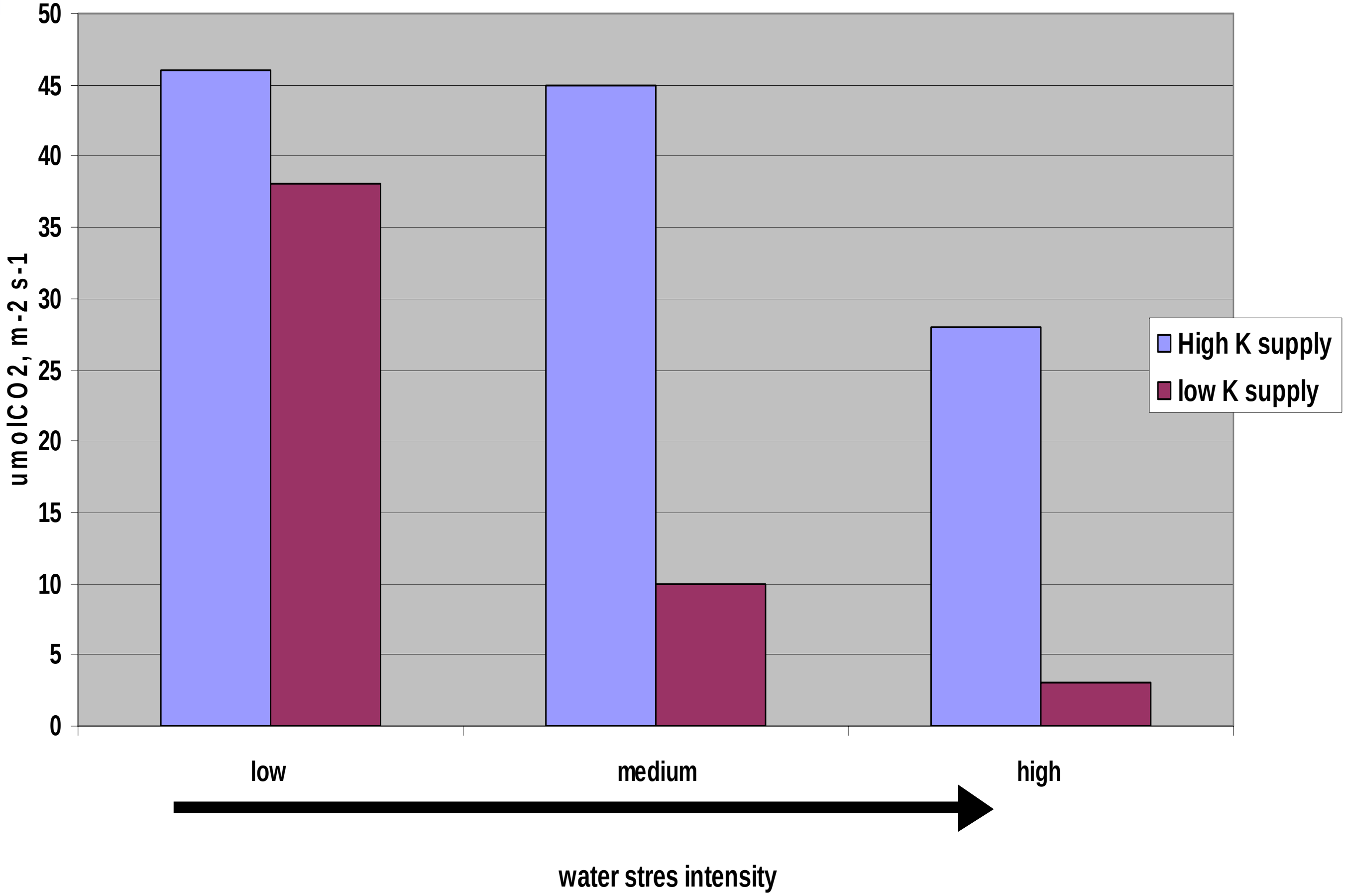
Weaver, 1926

Effect of soil type and water regime on K content in soil solution



Johnston, 1998

Potassium supply and gross photosyntesis



Gupta, 1989

Sugar beet response to potassium-water interaction (mean of 1999-2001)

Treatments: K treatments (A) Water treatments (B)	Yield t ha^{-1}	Relative yields %	Relative gains/losses %
(A) K fertilized			
Irrigated – I*	62,3	124	+ 24
Drought – D_1	43,8	87	- 13
Drought - D_2	37,2	74	- 26
Control – C	50,3	100	0
(A) K non-fertilized - K			
Irrigated – I	49,2	98	- 2
Drought – D_1	34,1	68	- 32
Drought – D_2	33,2	66	- 34
Control – C	43,0	85	- 15

Musolf, 2004

Spring triticale response to potassium-water interaction (mean of 1995-1997)

Treatments: K treatments (A) Water treatments (B)	Yield t ha^{-1}	Relative yields %	Relative gains/losses %
(A) K fertilized			
Irrigated – I*	6,1	102	-02
Drought – D_1	4,9	82	-18
Drought - D_2	5,5	92	-08
Control – C	6,0	100	-00
(A) K non-fertilized - K			
Irrigated – I	4,5	75	-25
Drought – D_1	2,1	35	-65
Drought – D_2	2,9	48	-52
Control – C	5,5	92	-08

[1]source: Wyrwa (1998)

[2] Irrigated at EC 30-37 and EC 65-80

Conclusions – soil content of potassium is decisive for

1. Soil water accumulation;
2. Nitrate nitrogen uptake;
3. Vigorous plant growth;
4. Water plant economy;
5. Drought resistance;

Resulting in:

1. Higher plant productivity

not only under stress conditions.