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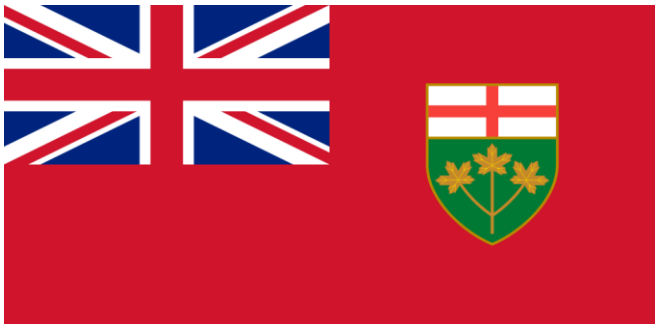
Important changes of onion plant behaviours on its way from seed to maturity

Peter Grauert; Norseco; Canada; August 2014

NORSECO

Thank you for kind Invitation and Interest



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Merci beaucoup pour l´invitation

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C.V.– Peter Grauert

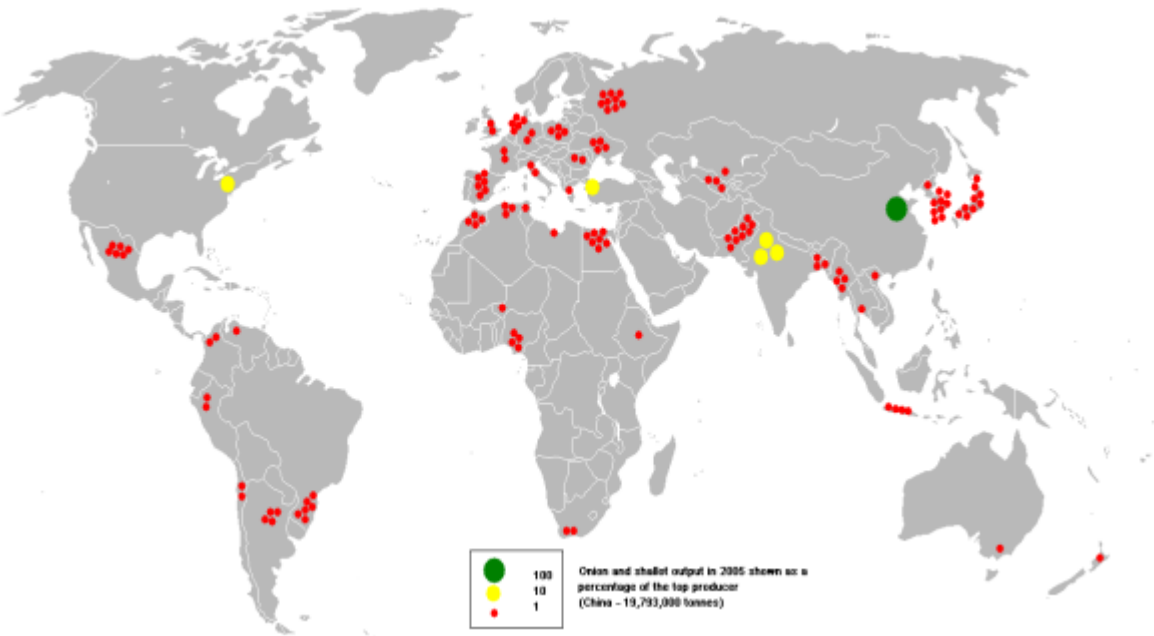
- Agricultural education at Justus v. Liebig University Giessen (Germany)
- PhD in applied Genetics
- Product Management for International Vegetable Seed Company (focus : onion).
- 2,5 years in Italy production manager for counterseason export (incl. overwintering onion)
- Since 1990 responsible for Limagrain vegetable seed sales Germany, A, CH, SK, CZ
- Retirement 10/2012
- November 2012 establishment of **concepa**

Issues of Presentation

- The onion world and main markets
- Discussion how to benchmark and how to translate results from elsewhere
- How does the photoperiod work and what does it mean for a local grower
- Discussion of major production hazards
- Nitrogen – discussion
- Maturity and dormancy
- Questions and hopefully answers

The onion world production (FAO 2011)

Table:-1 Area, production and productivity of onion in major onion producing countries during 2008			
COUNTRIES	Area ('000 ha)	Production ('000 MT)	Yield (MT/ha)
China	1001171	20817295	20.79
India	804600	8178300	10.16
United States of America	62120	3349170	53.91
Pakistan	153100	2015200	13.16
Turkey	75000	2007120	26.76
Russian Federation	128600	1900000	14.77
Egypt	52885	1728417	32.68
Iran, Islamic Republic of	50000	1700000	34.00
Brazil	63639	1299815	20.42
Mexico	42998	1252441	29.13
Japan	24500	1165000	47.55
Netherlands	26200	1130000	43.13
Spain	21100	1098400	52.06
Ukraine	62000	1049200	16.92
Korea, Republic of	15392	1035076	67.25
Bangladesh	125226	889260	7.10
Indonesia	91780	824064	8.98
Myanmar	60000	740000	12.33
Uzbekistan	23000	728000	31.65
Argentina	24000	700000	29.17
Algeria	38000	700000	18.42
Morocco	27900	662140	23.73
Peru	18879	634393	33.60
Nigeria	42000	621000	14.79
Poland	30187	618233	20.48
Germany	8942	407602	45.58
Italy	13589	403521	29.69
Romania	34810	395579	11.36
South Africa	17000	380386	22.38
Kazakhstan	18500	376840	20.37
Niger	10500	373637	35.58
United Kingdom	8575	349200	40.72
WORLD	**3731659**	**66829917**	**17.91**



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Evolutionary Background of Onions

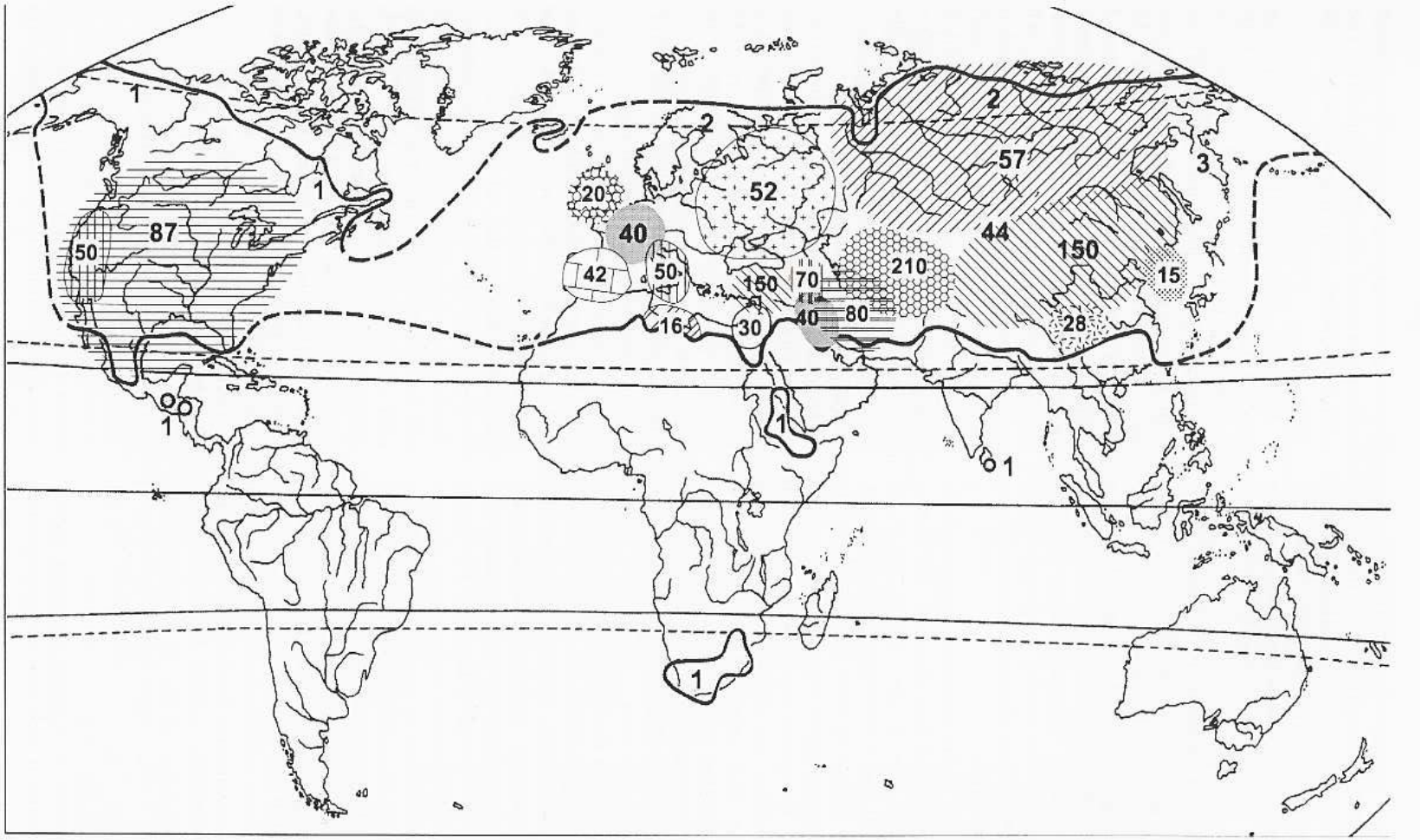

Fig. 1.1. World distribution of wild species of the genus *Allium*. The numbers on the map indicate the number of species found in each region.

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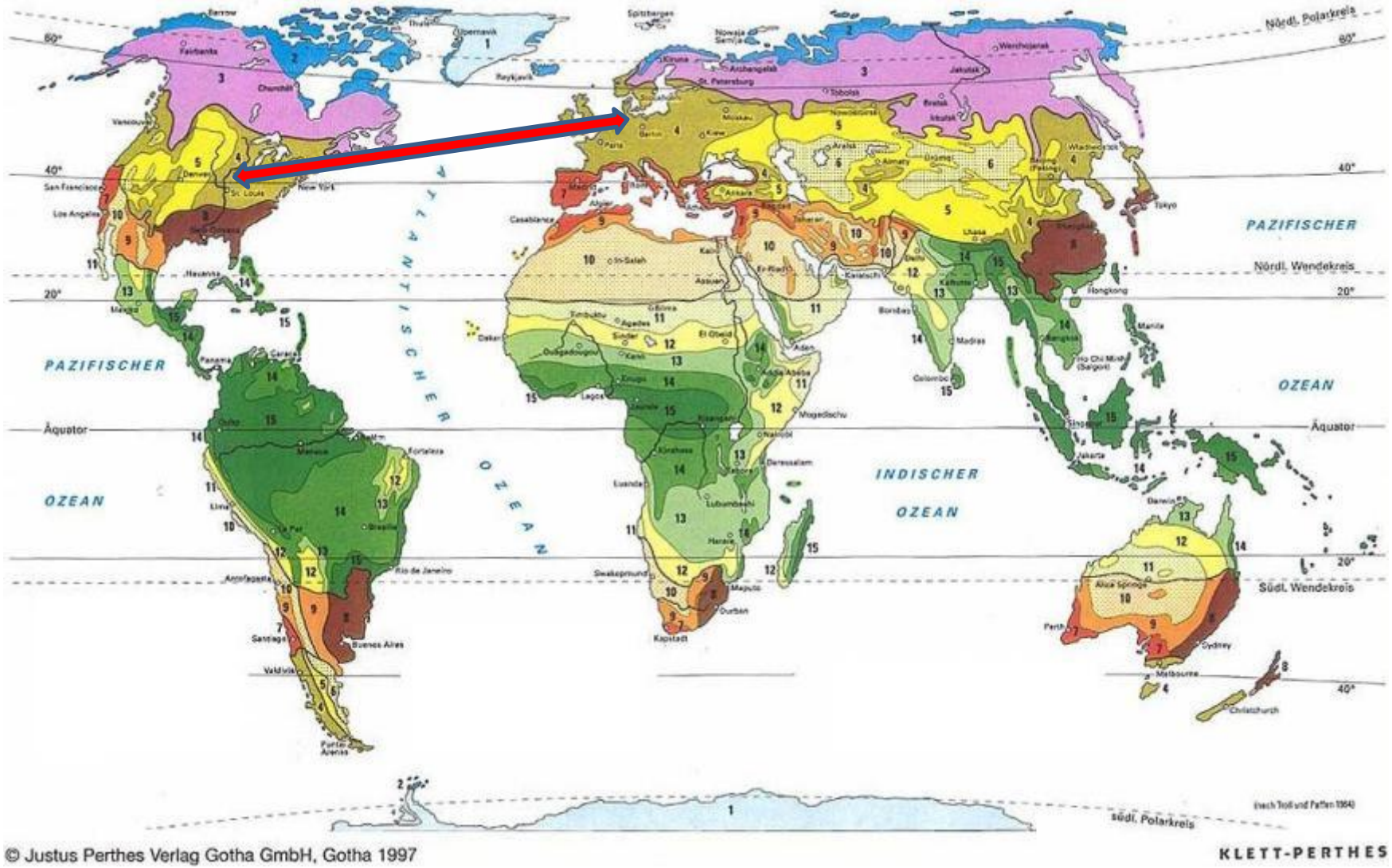
Climates and Latitudes



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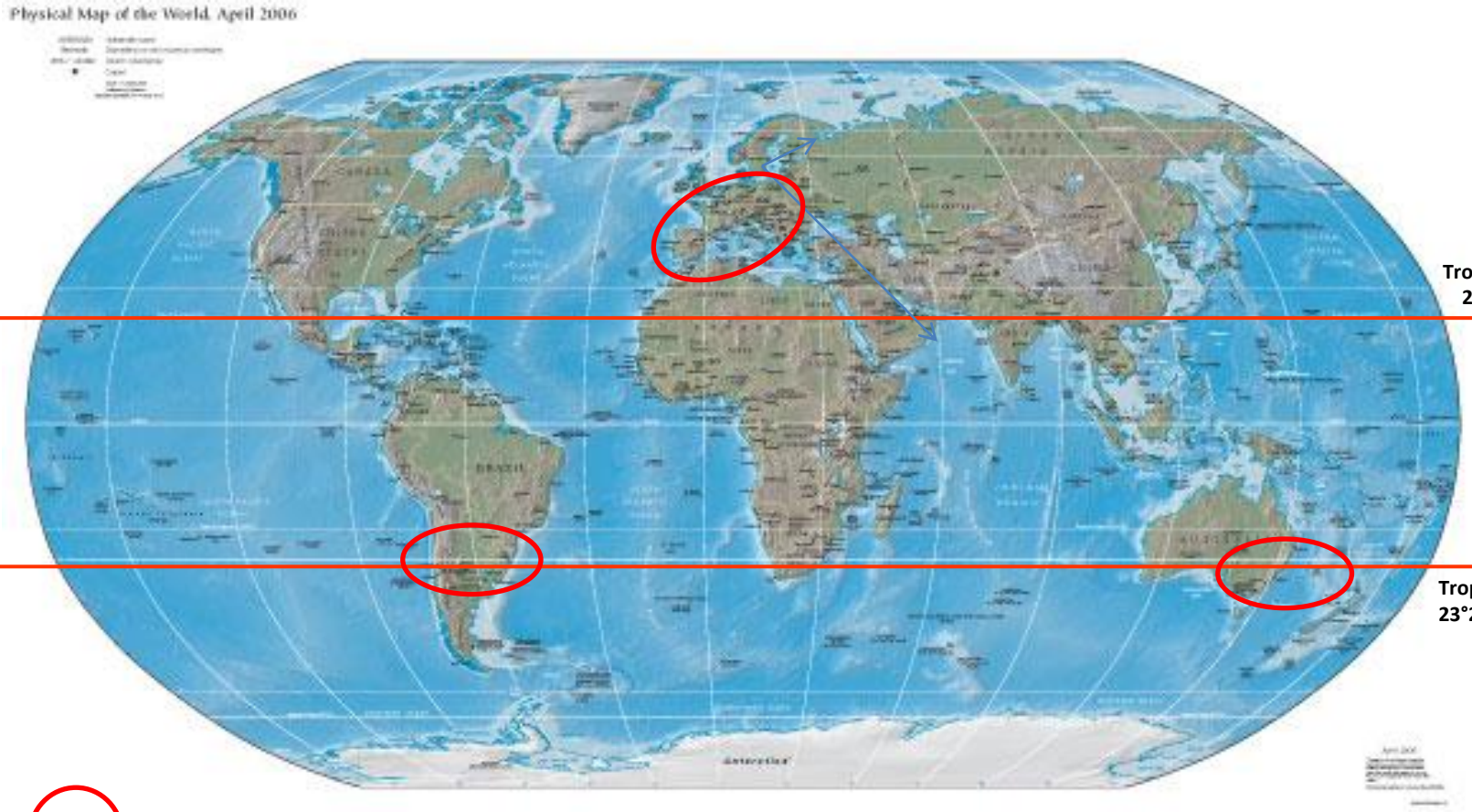
The Hemispheres and available Landmass



Few areas only where production of qualities for global trade is possible

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World Onion Production (FAO 2011)

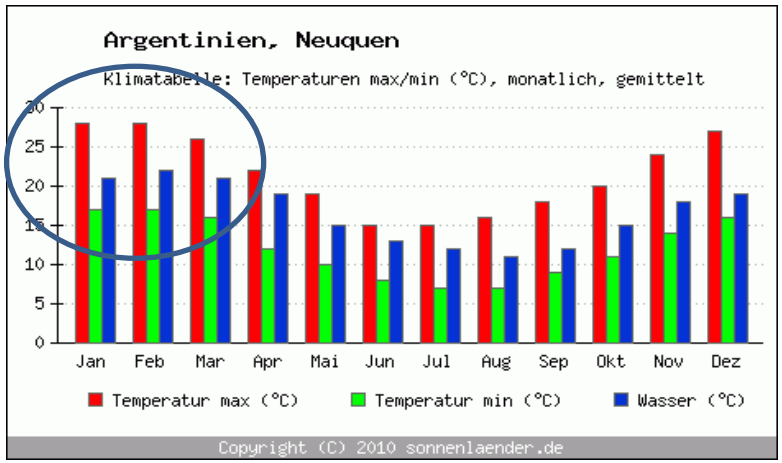
- Onions are planted in 175 countries = global crop like tomatoes
- The production is abt 46,7 Mio to
- The surface is 2,7 Mio ha
- Average yield accordingly abt. 17,3 to/ha
- Abt 8 % of production only is traded internationally -> price levels!
- By far largest oversea shipping areas are Netherlands and Oceania

Advantages of NL and Oceania onion production

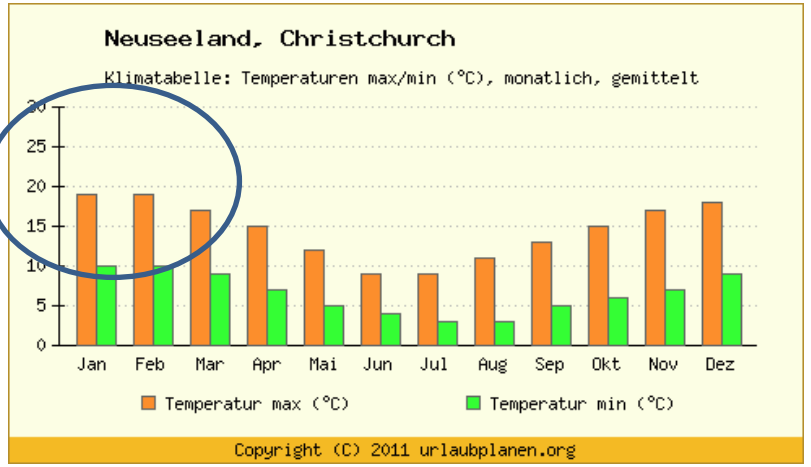
- **Climatical conditions allow to grow varieties fully mechanised**
- **The varieties are hard and suitable for bulk storage > 4 m high and handling (big bags)**
- **The varieties available show good skin retention and hardiness and storability**
- **Qualities allow oversea long distance shipment**
- **Excellent infrastructure for oversea transport in esp. In Netherlands**

Comparison of related Onion Areas

Heat peaks in summer

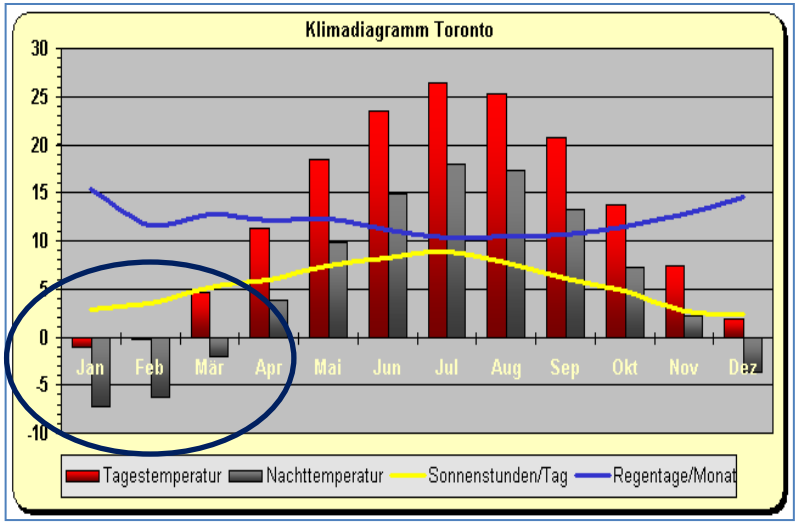


38°47'16.85"S

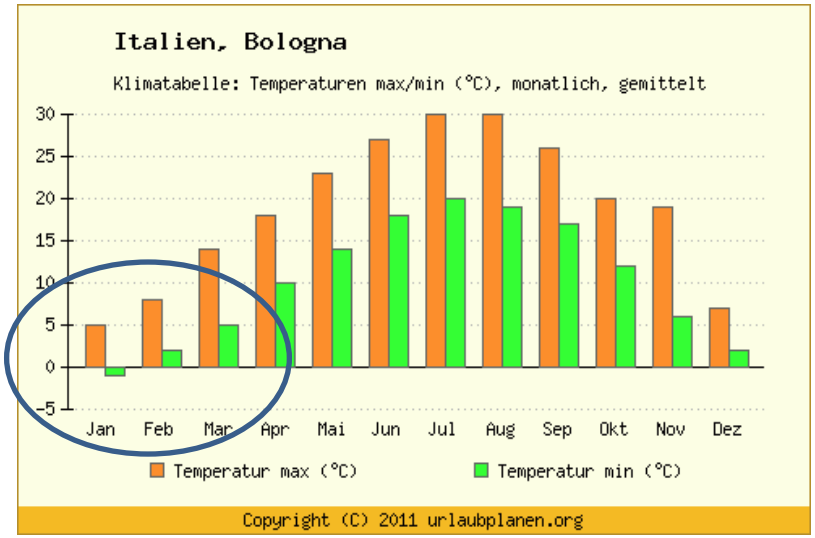


39°14'17.15``S

Frost periods in spring



Bradford 45° 3'28.77"N



44°32'8.58"N

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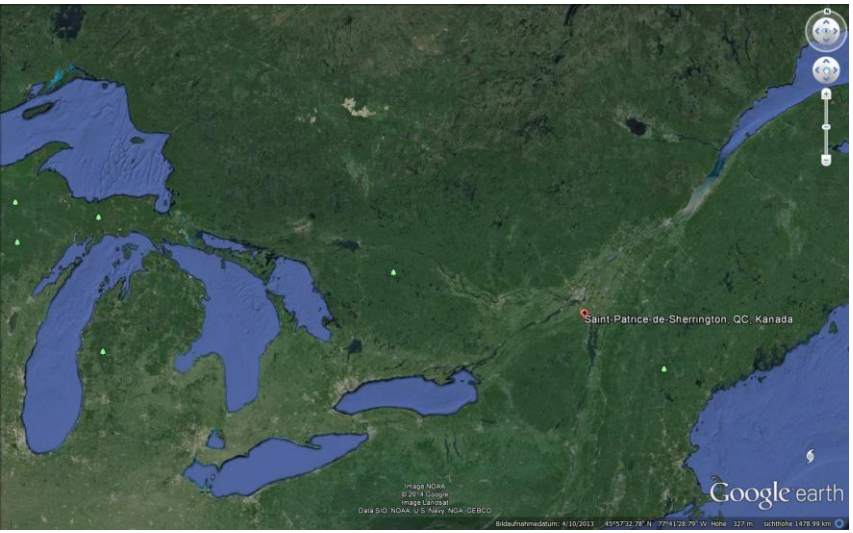
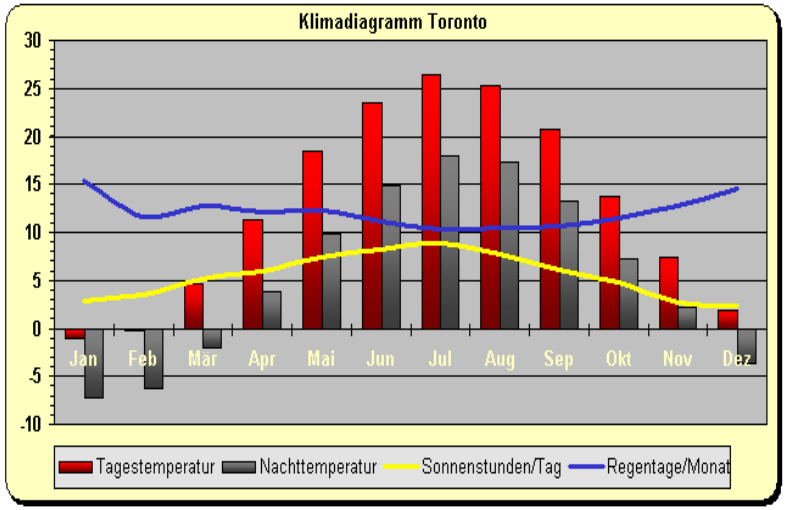
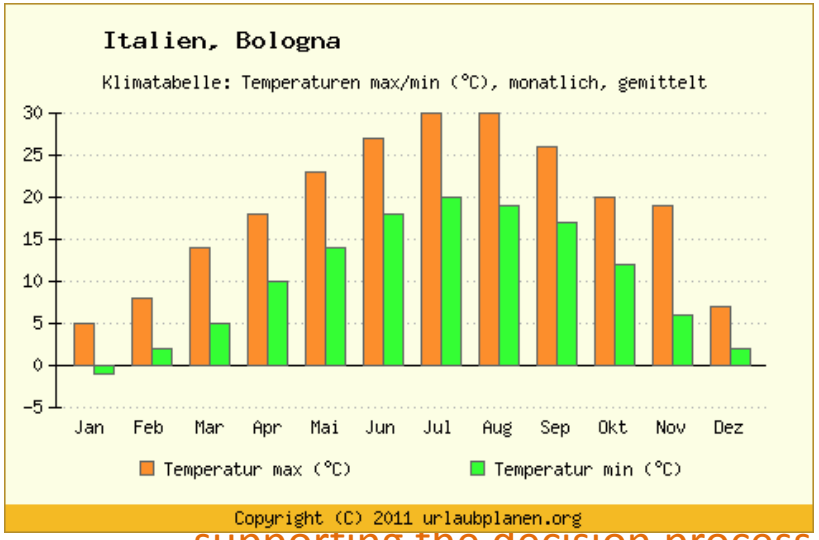
Comparable Areas ?

Bradford ON: 45° 3'28.77"N





Bologna Italy: 44°29'41.62"N



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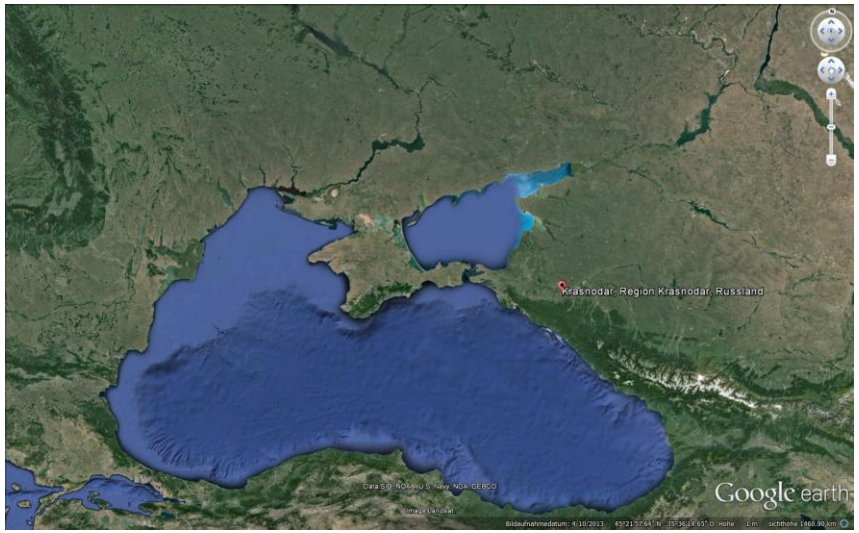
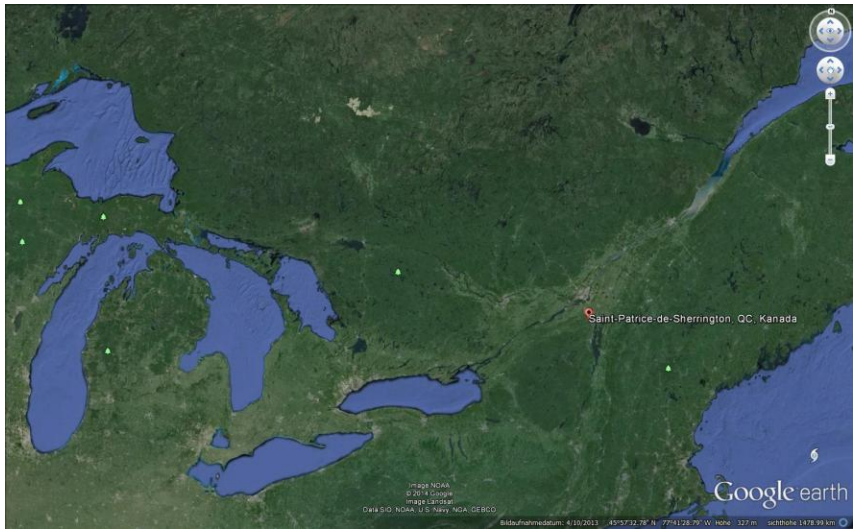
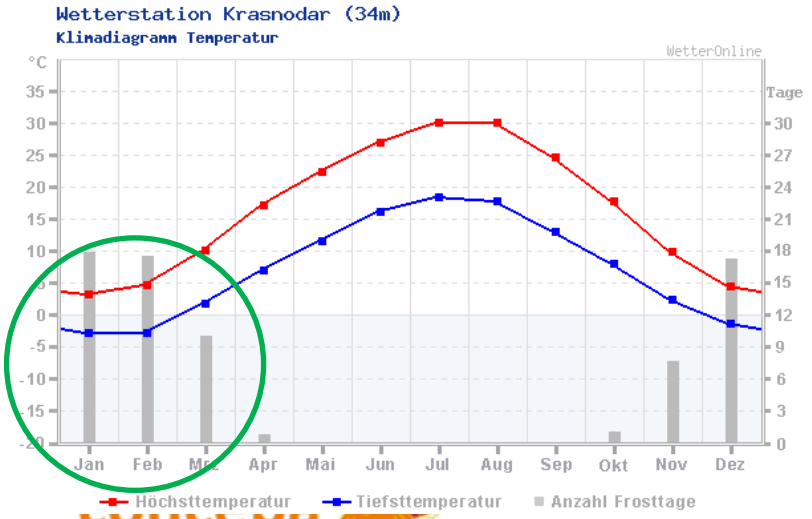
Or better Krasnodar?

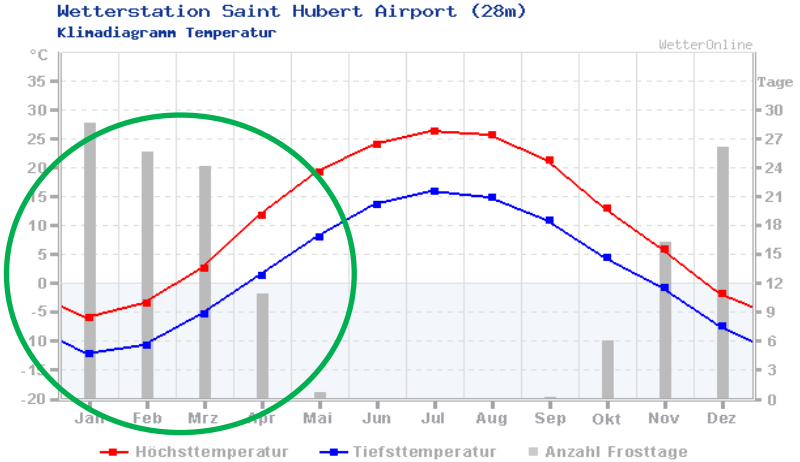
Krasnodar : 45° 4'3.82"N



Sherrington QC :45° 9'55.54"N







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Basic principles of the onion crop

- Photoperiodic reaction for bulb induction
- Predominantly a water storing crop
- Leaf canopy index 40 % only
- Bladeless scales make up to more than 50 % of bulb diameter = yield inside !!
- Storage and skins dependant very much on achieved dormancy (phytohormonal)
- Temperature reactivity often underestimated

„The plant with the sundial“

The daylength calendar is very much more reliable than the cumulation of heat units to change important development stages

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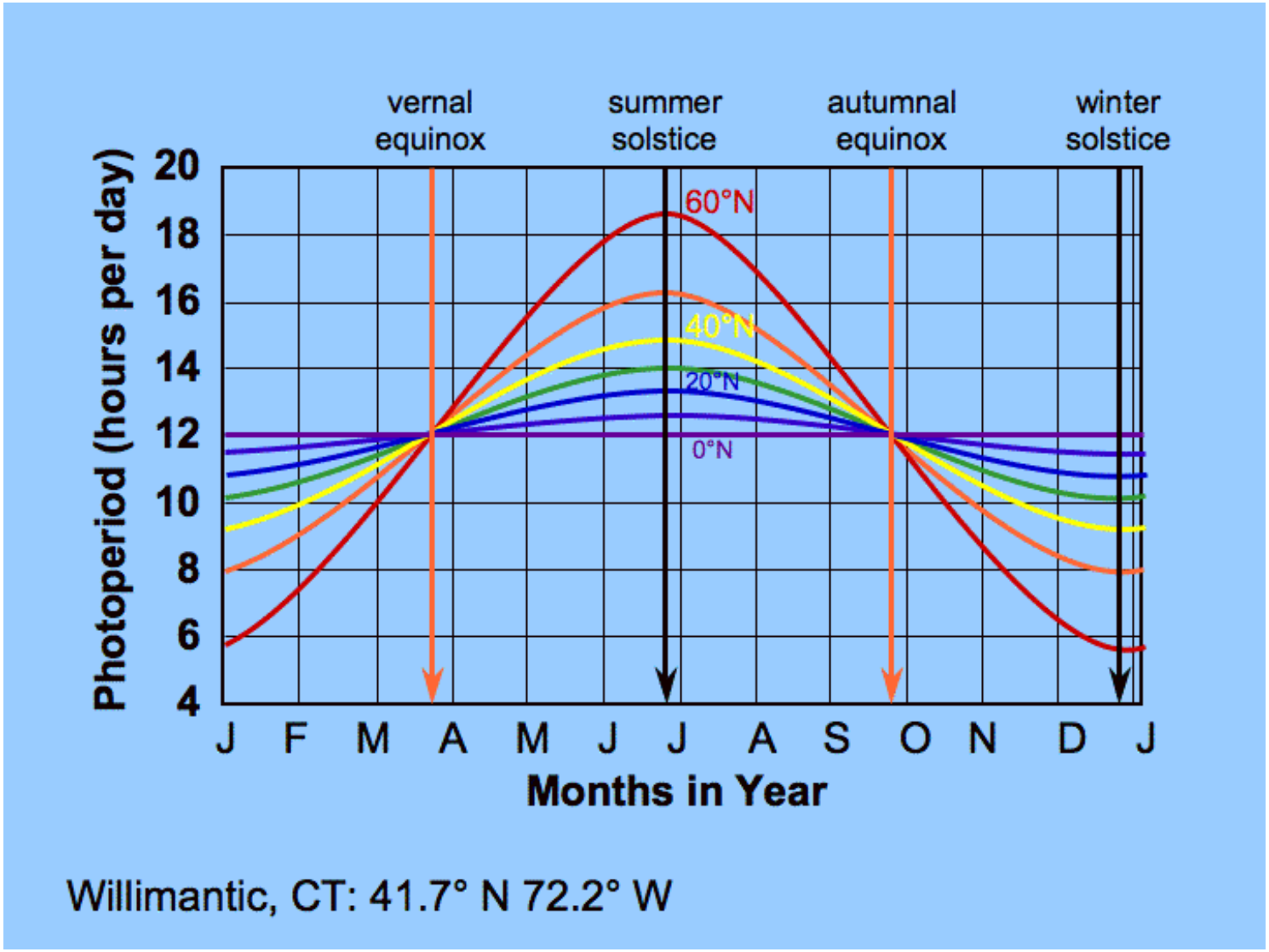
Equinox 2x per Year

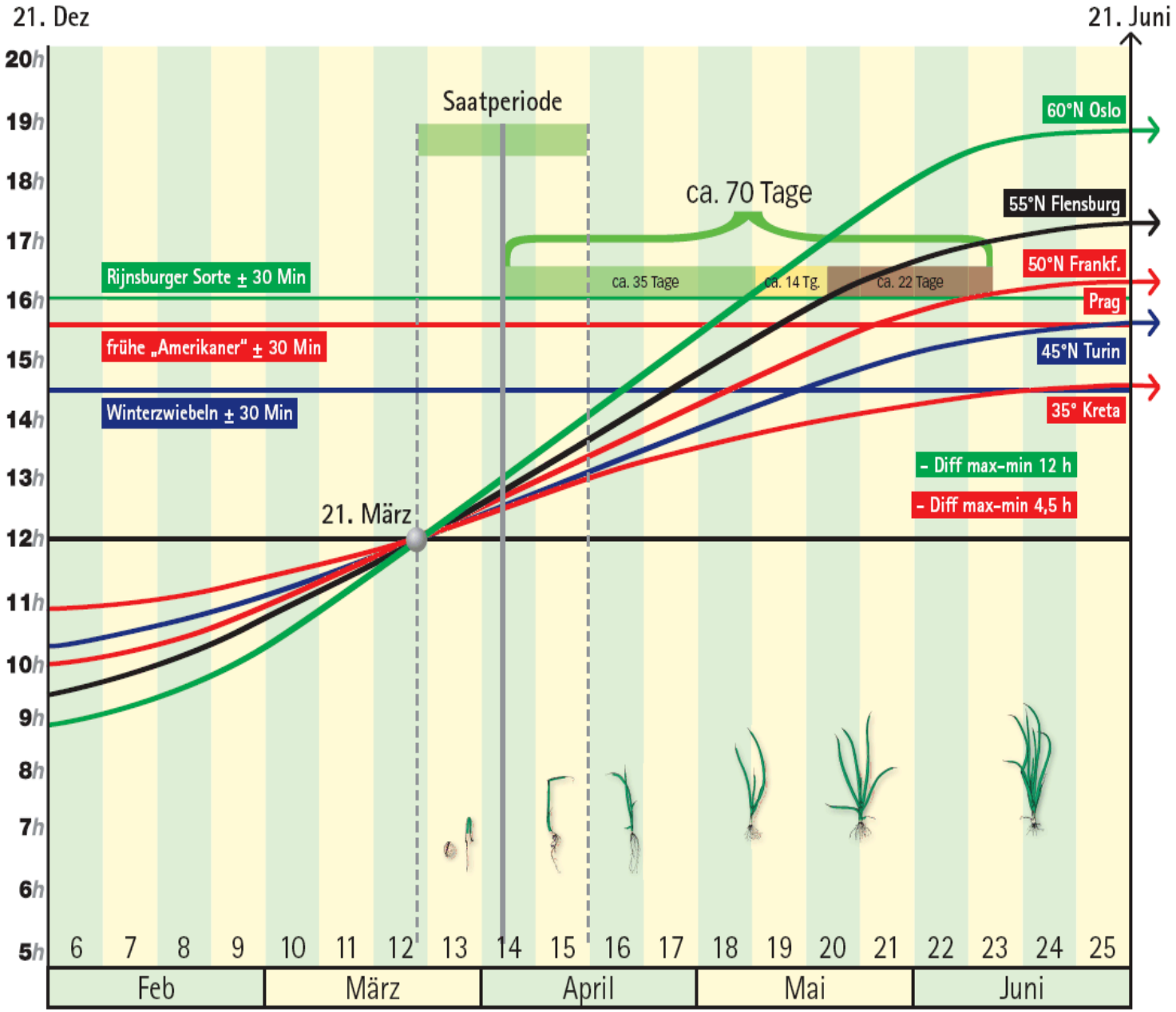


Rijns = X-tra Long day >16 h

US hard globe = Long day >14 h

Ov-Wint = intermediate abt 14 h

(Short = abt 12h – 13 h.)



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One may make it complicated and loose track

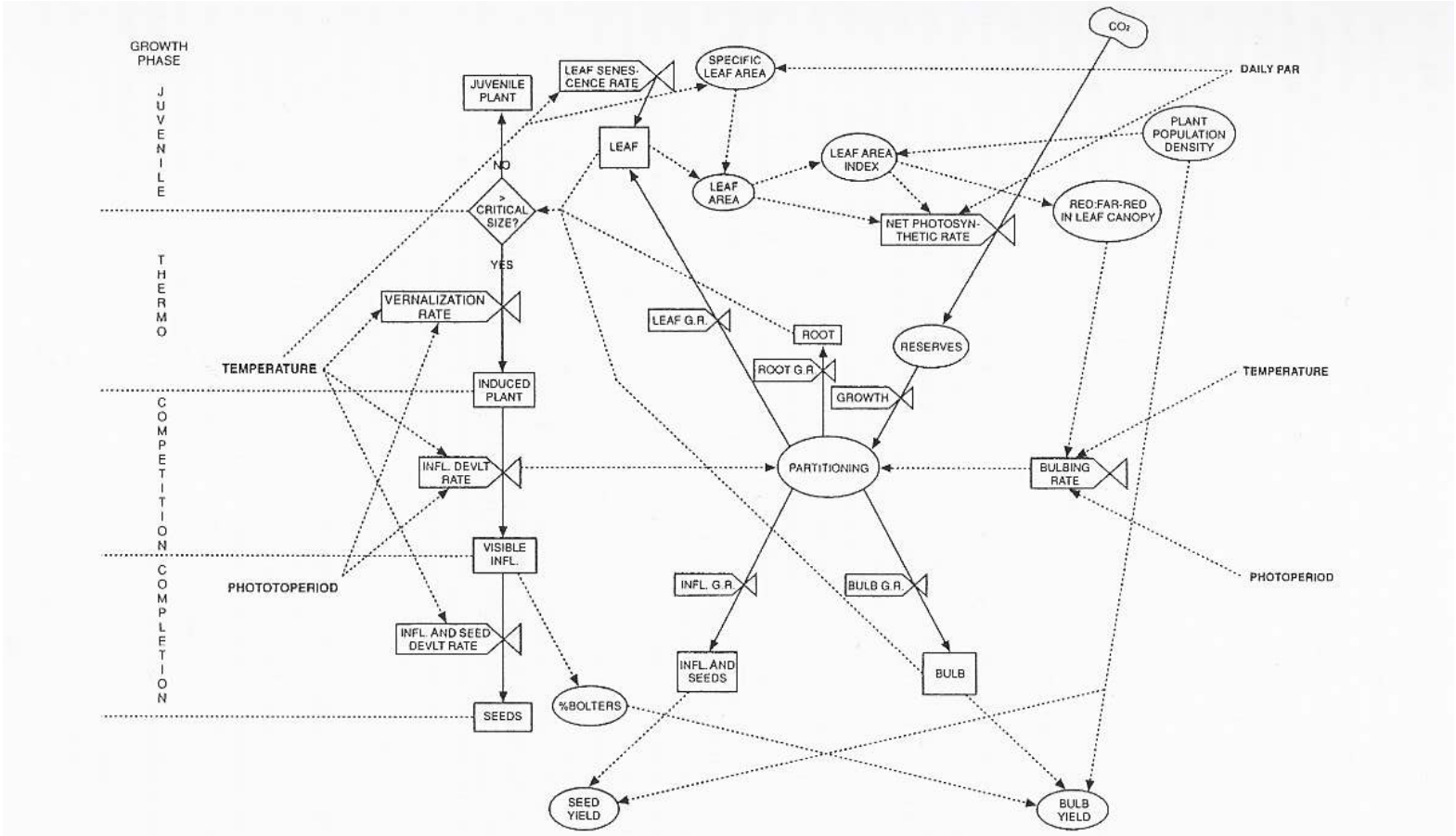

Fig. 9.1. The main environmental controls of growth and development in onions, showing how growth, bulbing and flowering interrelate to determine bulb or seed yield. Devlt, development; infl., inflorescence; G.R., growth rate (based on dry matter); PAR, photosynthetically active radiation. (From Brewster, 1997, with permission.)

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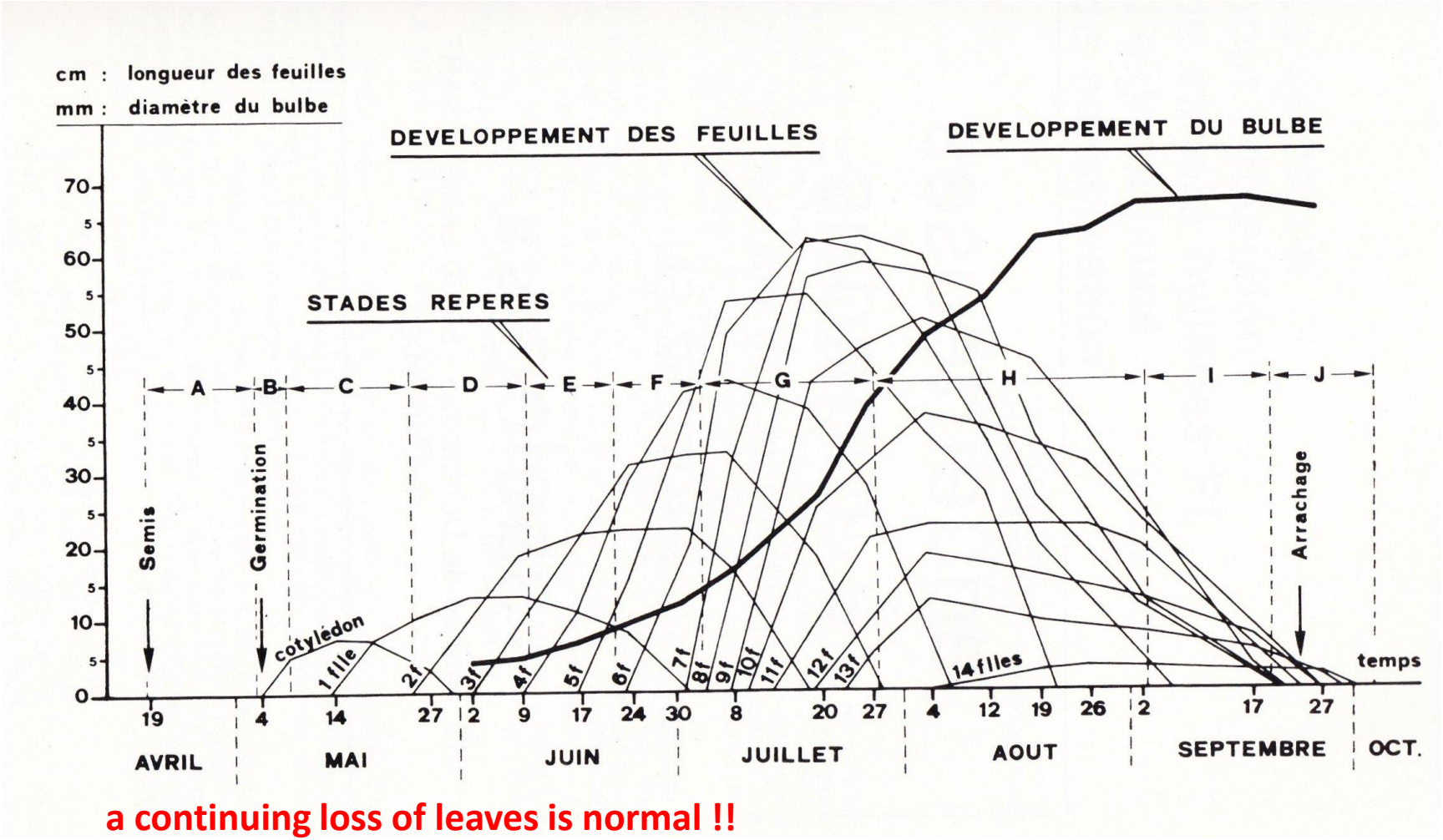
The Development -Stages



a continuing loss of leaves is normal !!

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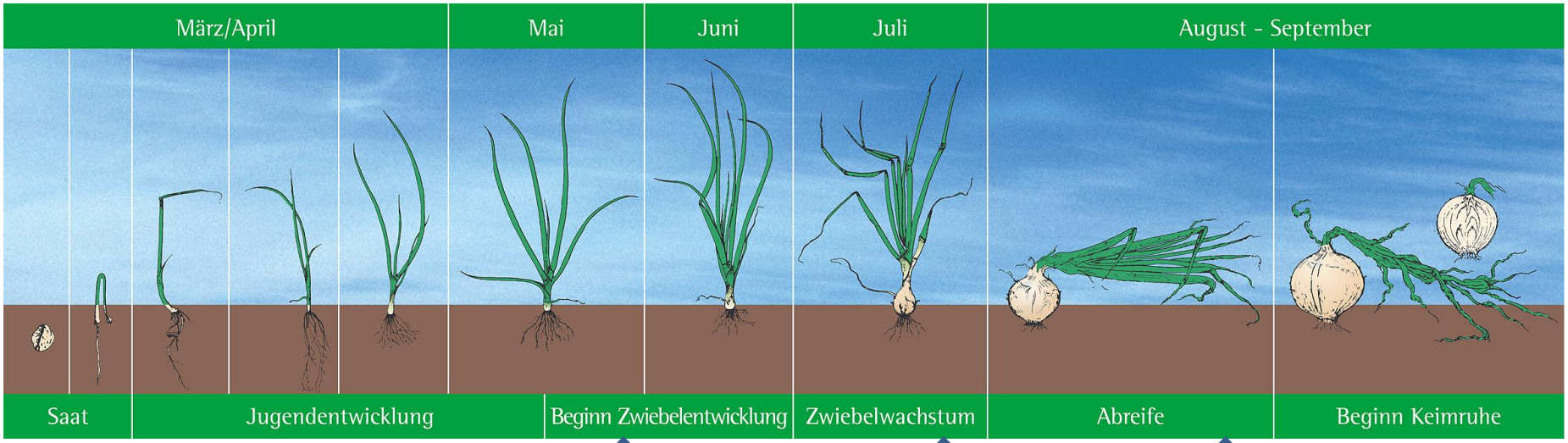
The growing calendar for onions and the pyhsiologically important stages

->Seedling establishment and Vegetative leaf growth ->



UK : 110 days
NZ : 130 days
PL : 90 days

Bulb – induction LD **->Bladeless scales** **->dormancy**

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Conclusions for the market

- **From climatic basis data one can preselect suitable cultivars**
- **Only few production areas show sufficient coincidence of factors which allow production like NW-Europe or Oceania**
- **Seed production needs > 12 hours plus sufficient vernalisation**
- **The physiology of crop requires a very specific hazard management or risk anticipation**

Conclusion for the local grower

- **Growing stages defined by calendar !!**
- **Do not compensate late sowing by early variety - > vice versa please**
- **Growth stops after bulb induction may cause major trouble until no bulbing at all**
- **Treat the crop as gentle as possible in iuvenile stage !! (attn. : herbicides)**
- **Fertiliser needs have two main phases**

Why „Hazard – Management „ in onions

- **Outdoor production shall be understood as a series of „hazards“**
- **Very Long life cycle incl. storage**
- **Specific physiology to change stages**
- **most hazards make anticipation of problem necessary (f. ex. Weed controll , Peronospora, soil born fungi etc.)**
- **Fertilisation according to stage**

Conclusion : the better you understand the crop physiology the better the decision process.

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No 1 Challenge : Uniform Seedling establishment !!!

- Respect sowing period
- Soil preparation
- Irrigation - > seed swelling -> Germination
- Keep time windows for germination process as small as any possible
- Improves weed controll reducing damages on later germinating seedlings
- Every growing day before bulb induction counts

Sowing time

In principle frosthardy

Prefer best possible soil condition!!

- Patience !!
- Soil Temp > 6 C
- Keep Soil surface open = Gas exchange
- Take care for good capillar water connection

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Risk of mechanical damage by Wind, Hail etc.

surface

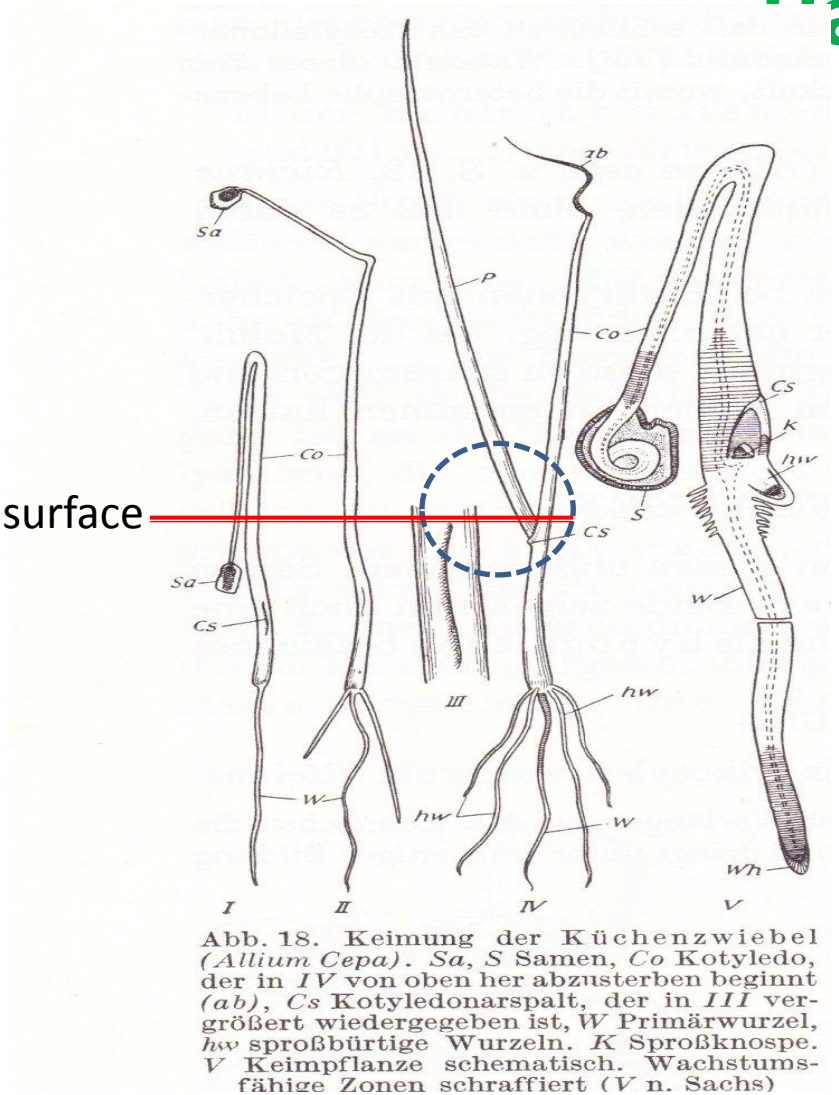

Abb. 18. Keimung der Küchenzwiebel (*Allium Cepa*). *Sa*, *S* Samen, *Co* Kotyledo, der in *IV* von oben her abzusterben beginnt *(ab)*, *Cs* Kotyledonarspalt, der in *III* vergrößert wiedergegeben ist, *W* Primärwurzel, *hw* sproßbürtige Wurzeln. *K* Sproßknospe. *V* Keimpflanze schematisch. Wachstumsfähige Zonen schraffiert (*V* n. Sachs)

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The discussion of plant distribution

….an endless story

Single rows in broad beds ?

Triple row on a 1,50 m bed ?

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The effect of single plant distance on size is very much less than often estimated

Taken North-West Europe

Taken in New Zealand

The seedling size at bulb induction decides

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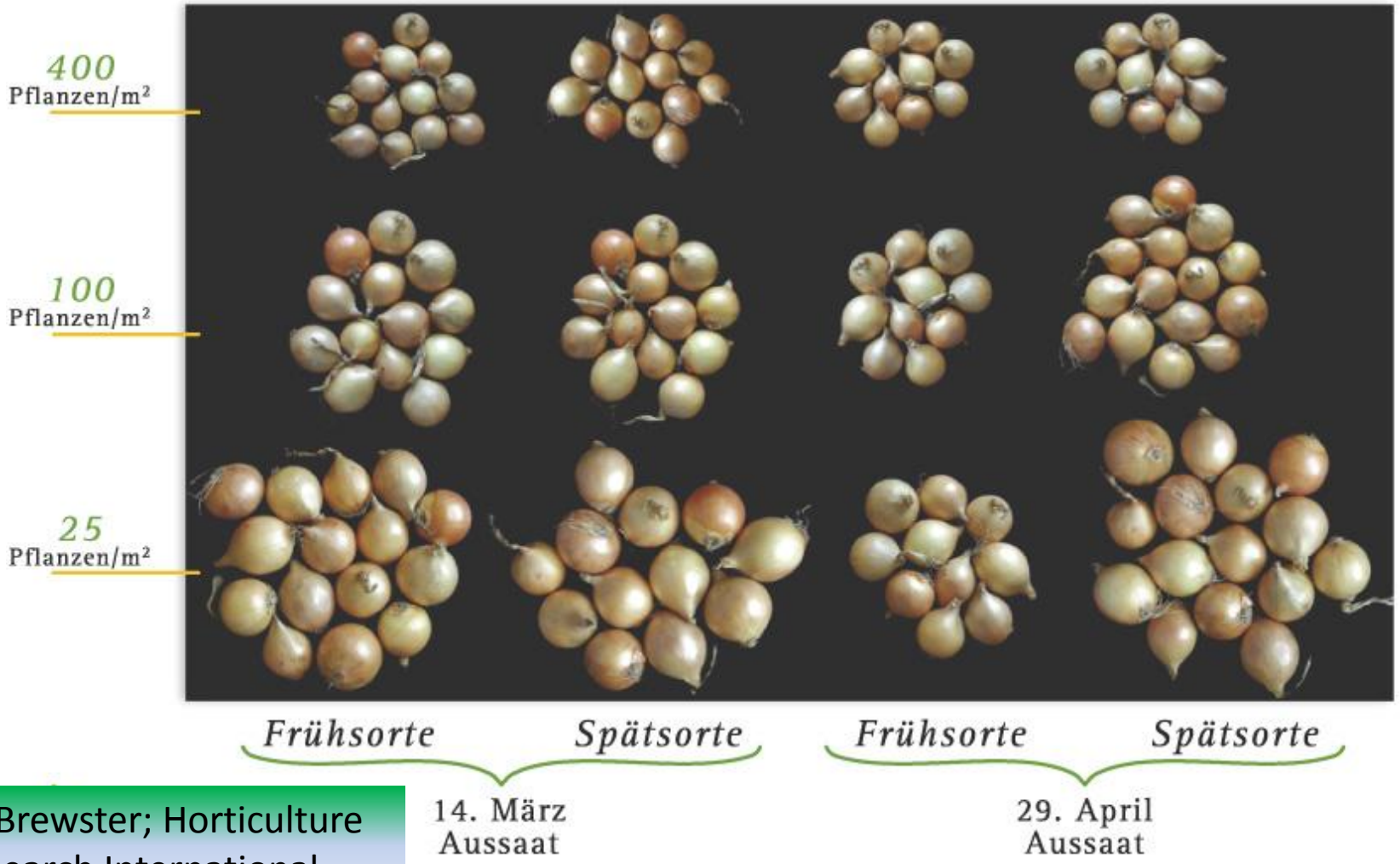
Sowing/planting period and bulbsize



J.L Brewster; Horticulture Research International

Onios and other vegetable alliums, J.L. Brewster, Cab International, page 98

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Population and bulb size

If they want to grow they just do

Uniformity of size is predesigned By uniformity of seedling establish ment.

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Uniformity of seedling establishment was and is crucial

Watch the undersized plts !

Pls note : this double row leaves room for additonal 10 – 11 full size plants while cost per squm are the same as for full population.

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The Plant Size when Bulbing defines the Yield Potential

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Leafless inner Scales = Bulb-Scales make more than 50 % of Diameter

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More scales in onions with longer growth phase before Photoperiod

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Uniformity more important than density of population !!

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The major challenges

- **Seedling establishment**
- **Weed controll**
- **Pests and diseases**
- **N - management**
- **Irrigation systems**
- **Maturity process**
- **Harvest and preparation for storage**

A Store is not a hospital !!

Germination and link to capillar water

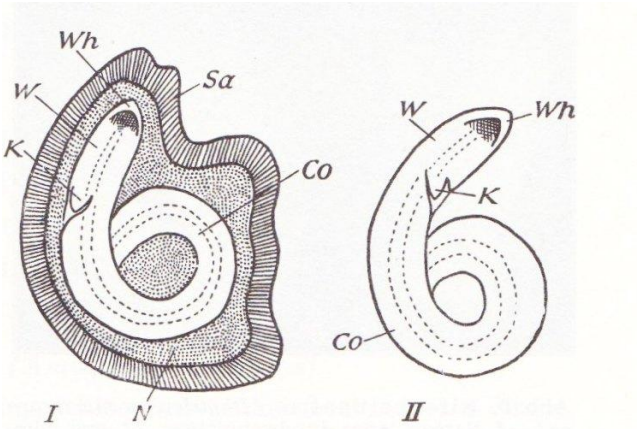

Abb. 7. *I* Samen der Küchenzwiebel im Längsschnitt. *Sa* Samenschale, *N* Nährgewebe; *II* isolierter Embryo, *Co* der schneckenförmig aufgerollte Kotyledo, *K* Sproßknospe, *W* Wurzelanlage mit der Wurzelhaube *Wh*

ATTN: shallow root system !!

No Hair – roots !!

Table 10

Root morphological properties of onions compared to other plant species

Crop	Root Radius (mm)	Root Hairs	
		No. per mm	Ave. length (mm)
Onions	0.23	1	0.05
Wheat	0.07	46	0.33
Tomato	0.10	58	0.17
Spinach	0.11	71	0.62

REF: FÖAHSE ET AL - 1991

Courtesy of YARA,Norway

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Weeds ?

- **Most discussion time in onion crop spent for weed controll**
- **Almost every herbicide application costs yield**
- **Splitting strategies preferred (small dosis frequently applied)**
- **Think about final cost of herbicides incl. Loss of yield**
- **Take mechanical options into account.**

Use herbicides in optimal condition for full efficiency !

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Totalherbicide before emergence??

Also very small weeds ….

…become big

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Timing of Herbicide is most important

- **No leaf active herbicides after bulb induction**
- **Try hard to wait for best wax layer on leaves**
- **Always low dosis frequently repeated**

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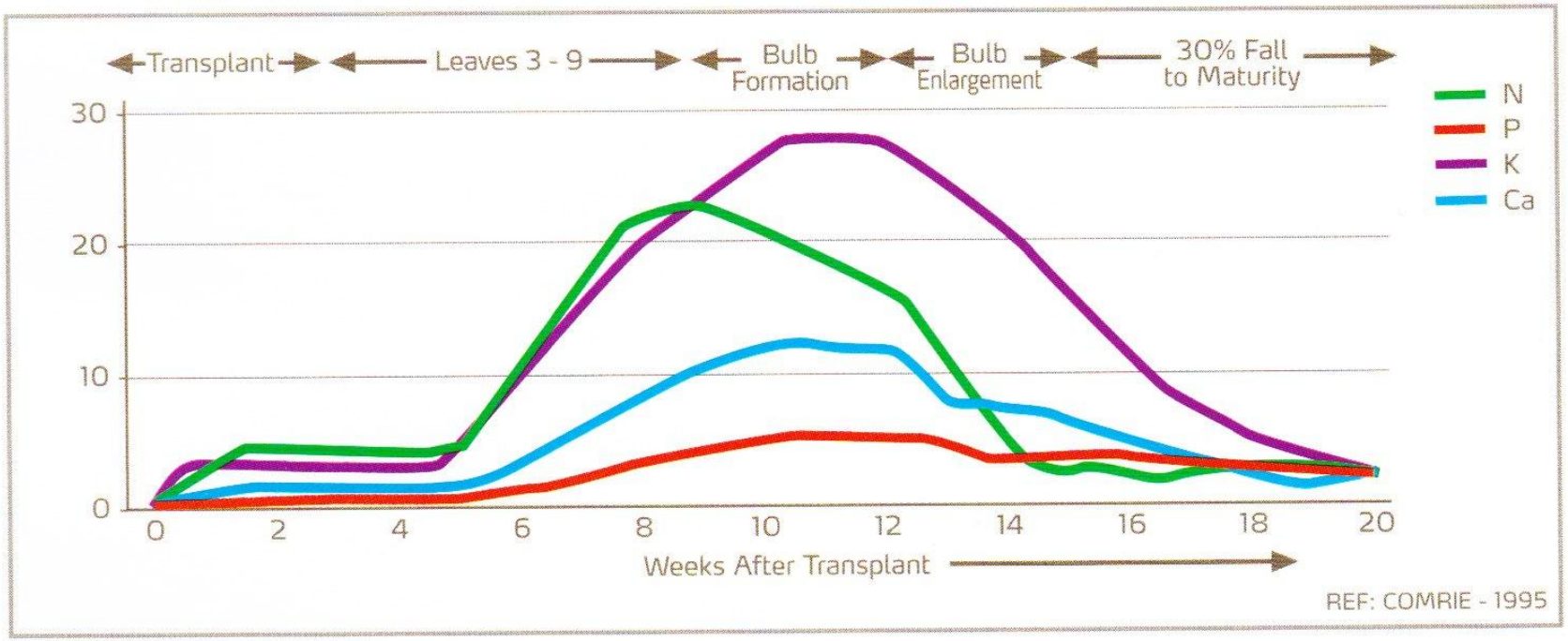
Nutrient needs with coincidence to Plant development curve

Figure 3

Major Nutrient Uptake - Whole Plant
(kg/ha/week) Onions - South Africa



Courtesy of YARA,Norway

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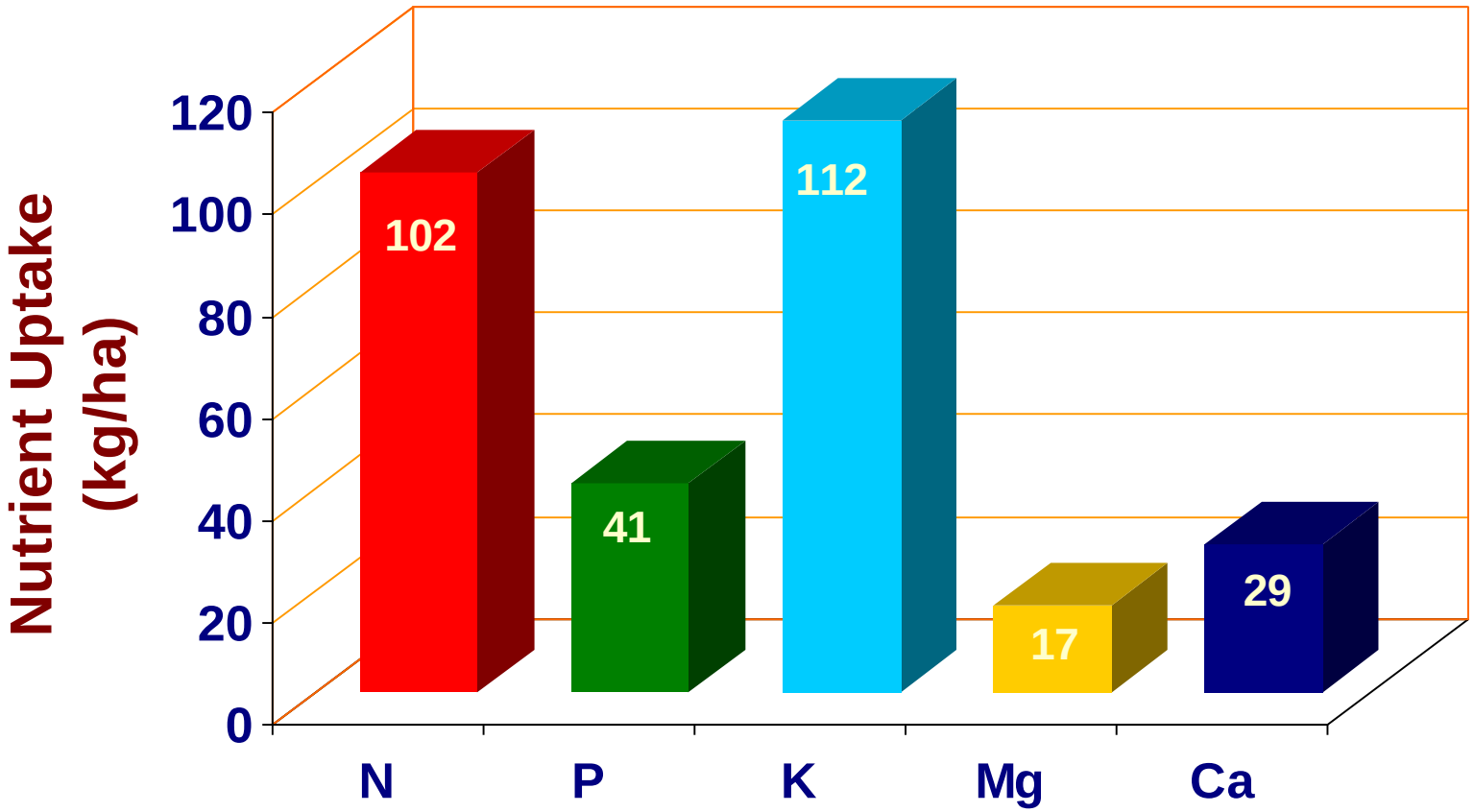
Uptake of major minerals by 60 to net yield



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Nitrogen Supply Strategy

- **N – supply according to real plant need**
- **Oversupply will be absorbed by the crop**
- **Rarely N – is really missing but frequently there is oversupply**
- **Late oversupply increases canopy on cost of bulb size**

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The onion N-min.-history in Germany

- **Middle of eighties public discussion of groundwater nitrate started**
- **First results to analyse in reliable way the mineralic N available in the ground = N-min**
- **Onions and in especially overwintering onions had become kind of bonanza – crop !!**
- **Second half of eighties first onions from southern hemisphere with excellent quality = strong competition in quality aspects !!**

Continued: N-min-history in Germany

- **Until mid of eighties until end > 200 kg N / ha**
- **Nobody took soil type, precrop or season into account**
- **Packers and dealers started initiative to improve quality of local production with overwintering onion**
- **Soil analysis systems became available**

What made it successful

The results from many fields and farms were almost always positive

The packers were very much behind the issue

The advisory situation in the according onion area was luckily excellent and interested

Problem today : the evaluation data are „lost“ as never in digits

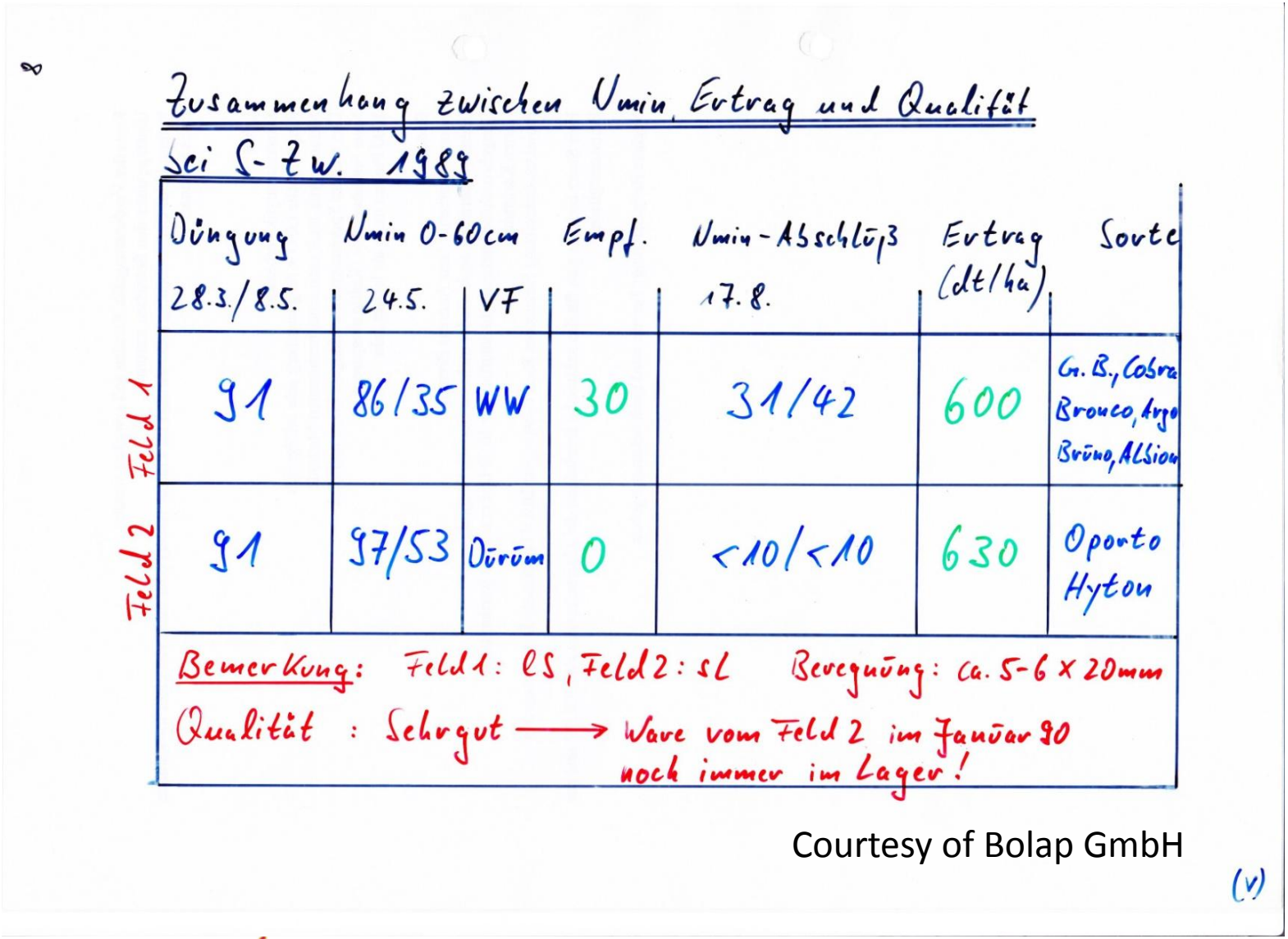
Necessities to apply an measured system

- **Farmers must trust !!**
- **System must be reliable**
- **The results need explanation and plausibility**

For ex. Repeat sampling etc. if plausibility is missing.

- **Needs convinced persons behind**
- **System needs to be adopted to local conditions**

Example of results spring sown onions



Zusammenhang zwischen Nmin, Ertrag und Qualität

sei S-Tw. 1989

	Düngung 28.3./8.5.	Nmin 0-60cm 24.5.	VF	Empf.	Nmin-Abschluß 17.8.	Ertrag (dt/ha)	Sorte
Feld 1	91	86/35	WW	30	31/42	600	Gr. B., Cobra Bronco, Argo Brüno, Alsion
Feld 2	91	97/53	Dürum	0	<10/<10	630	Oporto Hyton

Bemerkung: Feld 1: lS, Feld 2: sL Beregnung: ca. 5-6 x 20mm

Qualität: Sehrgut → Ware vom Feld 2 im Januar 90 noch immer im Lager!

Courtesy of Bolap GmbH

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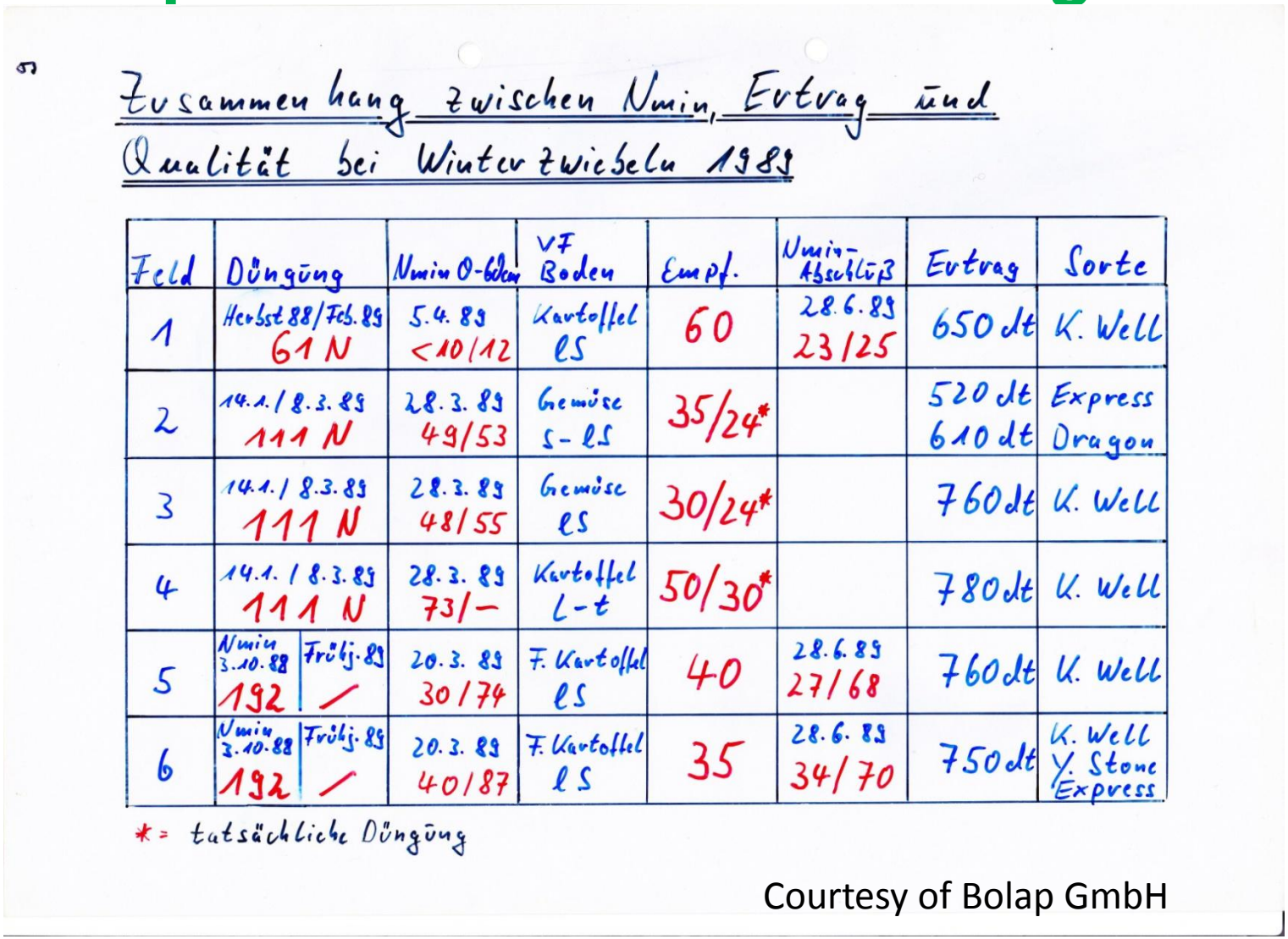
Example of results overwintering onions



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Zusammenhang zwischen Nmin, Ertrag und Qualität bei Winterzwiebeln 1989

Feld	Düngung	Nmin 0-60cm	VF Boden	Empf.	Nmin-Abschluß	Ertrag	Sorte
1	Herbst 88/Feb. 89 61 N	5.4.89 <10/12	Kartoffel lS	60	28.6.89 23/25	650 dt	K. Well
2	14.1./8.3.89 111 N	28.3.89 49/53	Gemüse s-lS	35/24*		520 dt 610 dt	Express Dragon
3	14.1./8.3.89 111 N	28.3.89 48/55	Gemüse lS	30/24*		760 dt	K. Well
4	14.1./8.3.89 111 N	28.3.89 73/–	Kartoffel L-t	50/30*		780 dt	K. Well
5	Nmin 3.10.88 192 / Frühj. 89 /	20.3.89 30/74	F. Kartoffel lS	40	28.6.89 27/68	760 dt	K. Well
6	Nmin 3.10.88 192 / Frühj. 89 /	20.3.89 40/87	F. Kartoffel lS	35	28.6.89 34/70	750 dt	K. Well Y. Stone Express

* = tatsächliche Düngung

Courtesy of Bolap GmbH

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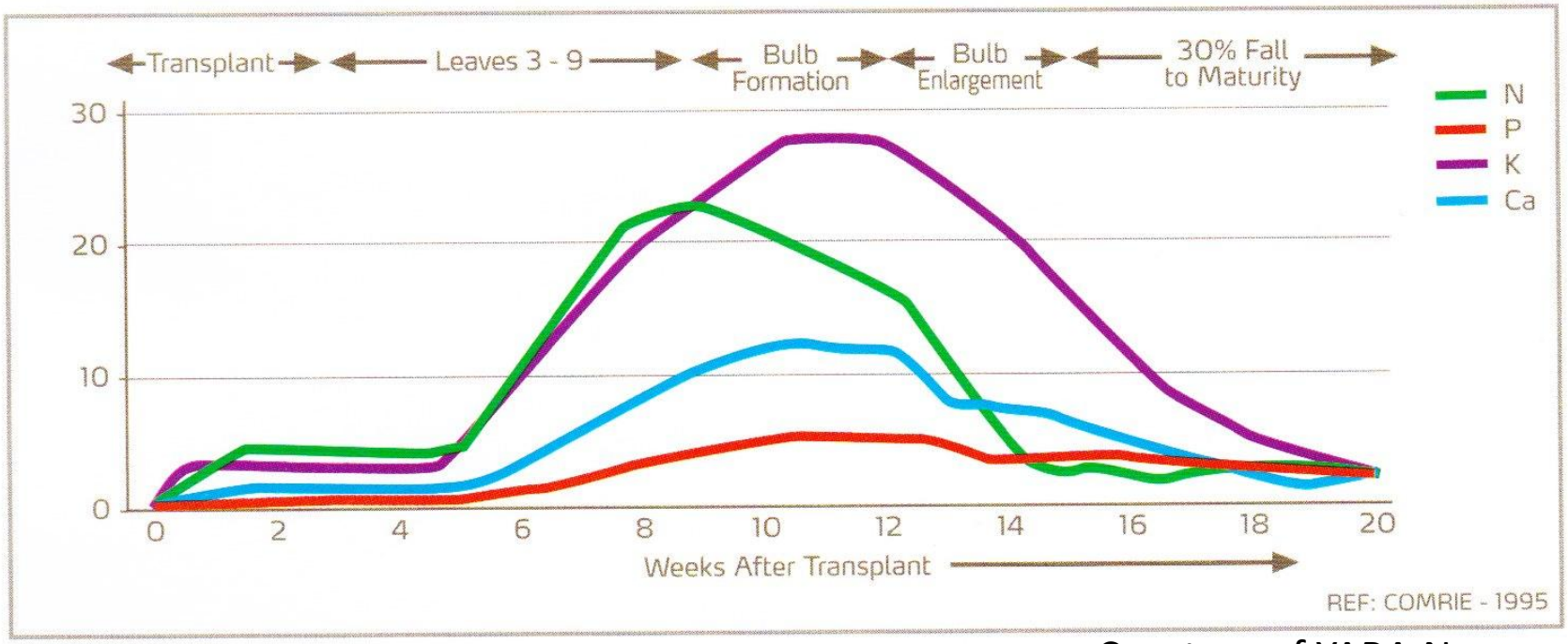
Nutrient needs with coincidence to Plant development curve

Figure 3

Major Nutrient Uptake - Whole Plant
(kg/ha/week) Onions - South Africa



Courtesy of YARA,Norway

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Exellent cooperation of all parties: public and private advisors, dealers and farmers

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Conclusions and situation today

- **About 40 % of former N-amounts applied today.**
- **The ability to measure allows a year specific N- supply**
- **Onion crop is ideal with its photoperiod driven physiology**
- **N-reduction does not lead to less yield but improved quality (skins, firmness etc.)**

Optimal maturity process

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Best way to achieve Dormancy and Skins ?

Lifting in time = cut from roots

Dry without topping

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Harvest Impressions

Argentina

Germany

South Africa

Spain

Morocco

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Maturity and Harvest – what is the „best“moment ?

- **>70 % of leaves shall have died „healthy**
- **Keep healthy until harvest !!**
- **Lifting accelerates maturity process**
- **Phytohormones steer the dormancy**
- **Dormancy likely supports skin development**
- **Topping after Dormancy is fully achieved !!**

overwintering onions June at Albacete SP

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Most important: meet and discuss with collegues

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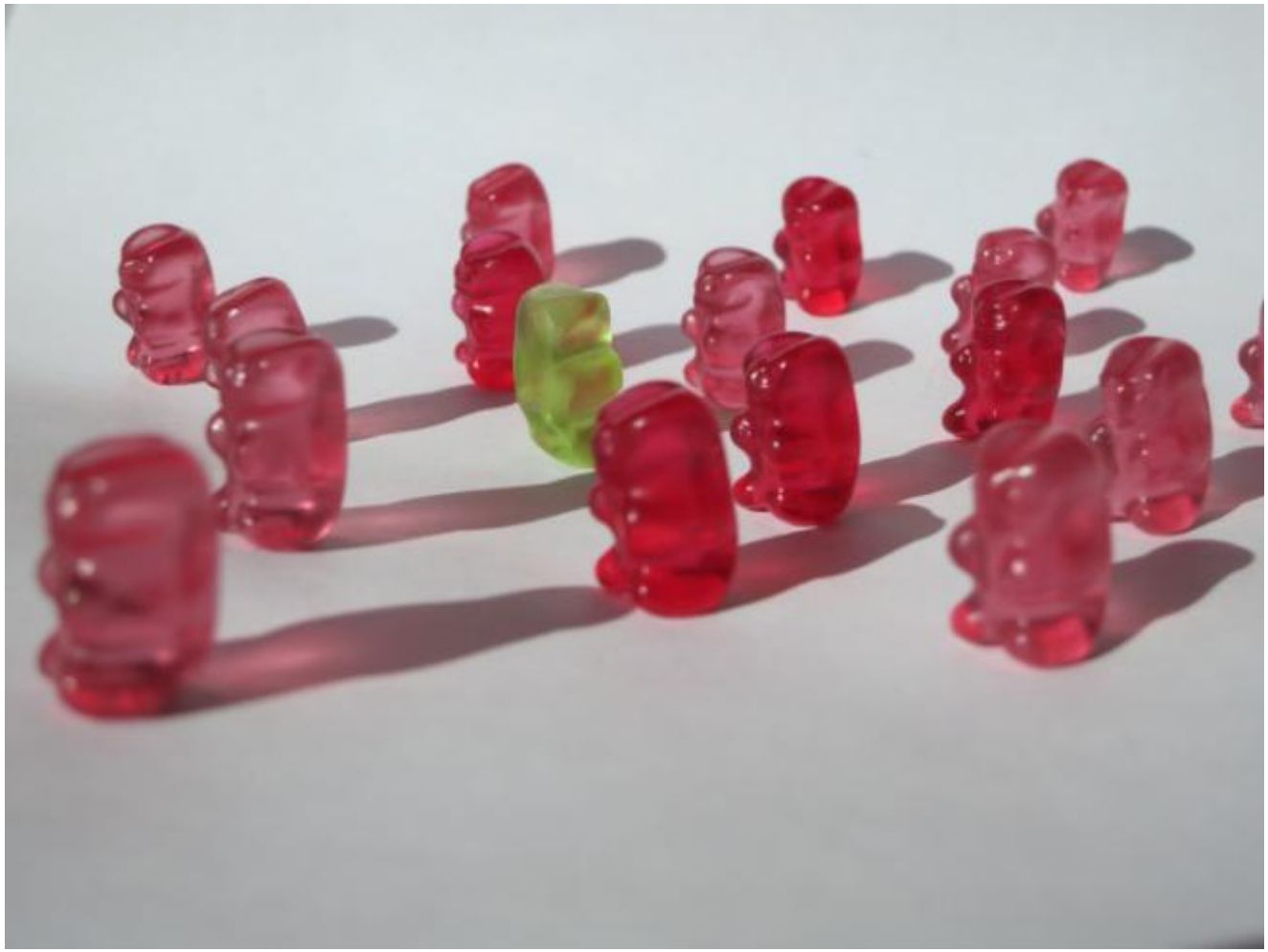
Always try to find and follow your own individual way



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What has happened here ???????
3 – 5 holes / sqm all over the field

Any other Question left ??

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