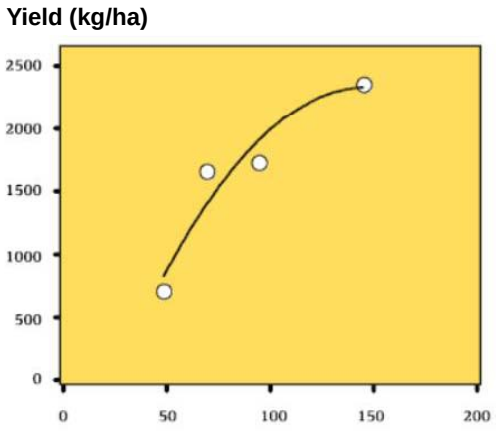
World‘s Top 15 countries in sunflower acreage

Country	Area (1000 ha)	Country	Area (1000 ha)
1. Russian Fed	5 003	11. Myanmar	540
2. Ukraine	3 411	12. **France**	534
3. Argentina	2 351	13. **Hungary**	505
4. India	1 880	14. Kazakhstan	350
5. China	1 020	15. South Africa	316
6. USA	813		
7. Romania	749		
8. Bulgaria	602		
9. Spain	601		
10. Turkey	552		

REF: FAO (2007)

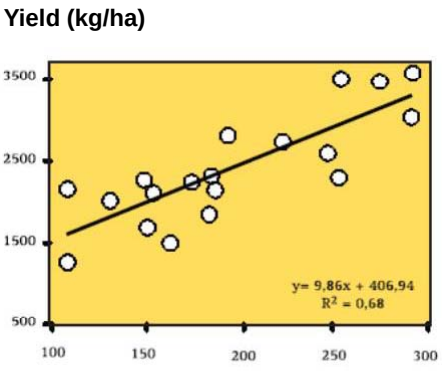
Influence of soil depth on yield

- Sunflower rooting system can go down to 2 + m
- The deeper the soil, the more water available
- Substantial nutrient uptake can occur from the subsoil



REF: Duarte et al. (unpublished) cited in Diaz-Zorita et al. (2002)

Optimum yield needs optimum water availability at seeding time



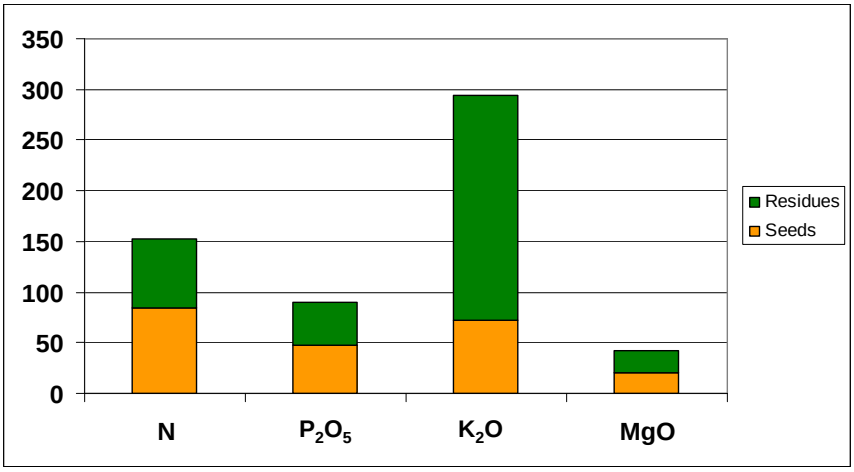
REF: Diaz-Zorita et al. (2002)

Nutrient uptake and removal of sunflower

Macro nutrients, kg / 1 t of seed production

Source	Country		N	P_2O_5	K_2O	MgO
KTBL (2005)	Germany	Removal, seeds	28	16	24	6,6
		Seeds + side products	51	30	98	14

Uptake and removal of N, P, K and Mg of sunflower at yield level of 3 t /ha



Micronutrient uptake and removal by sunflower at 3,5 t /ha yield level, g /ha

Source		Cu	**B**	Fe	Mn	Zn
Merrien, (IFA, 1992)	Uptake	59	**396**	732	412	348
	Removal	25	**80**	106	42	148

Good to remember about micronutrients:

- quantity needed by plants is ”micro”
- effect on yield and quality is ”MACRO”

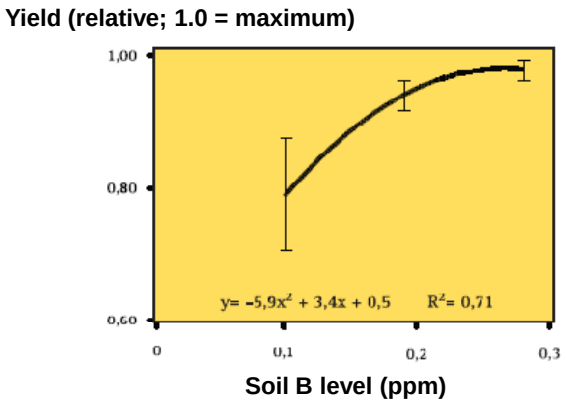
Boron deficiency

Visual symptoms:

- Hollowing of flower head

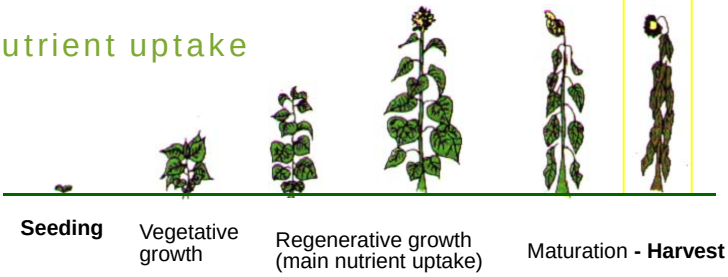
Photos: Yara Argentina

The higher the soil B level, the higher the yield



REF: Diaz-Zorita (2002) cited in Diaz-Zorita et al. (2002)

Nutrient uptake



- Sunflowers have a deep rooting system, and late in season its nutrient uptake from soil is high
- 75% of the nutrient uptake occurs during regenerative phases (Diaz-Zorita, 2002)
- However, most of fertilized Nitrogen uptake is between 10 leaves (B10) and start of flowering (F1) (France)
- Hence, main focus of base fertilizer application is to have an efficient starter effect

Soil N and N recommendation, France

Total N uptake is appr. 150 kg N /ha, and recommended fertiliser rate is up to 50% thereof :

NO_3-N in soil (kg/ha)	Yield target: 2.5 t/ha (shallow soil)	Yield target: 3.5 t/ha (deep soil)
30 (low)	40 - 80 kg/ha	> 80 kg/ha
60 (medium)	< 40 kg/ha	40 - 80 kg/ha
90 (high)	0	< 40 kg/ha

N application at sowing or 8-10 leaves stage

Fertilizer programme for sunflower, Germany

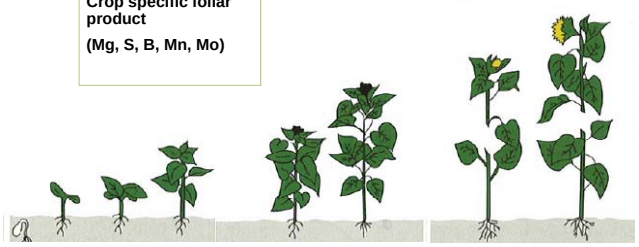
- at sowing / pre-sowing:
  - for soils with high P and K:
    200 – 300 kg/ha NS product: ***24 N + 6 S***
  - for soils with moderate/ low P and K :
    240 – 360 kg/ha ***NPK 20-7-10 +2 MgO+4 S***
- seasonal foliar application:
  - YaraVita™ Brassitrel, 3 kg/ha in 200 l/ha at 4 - 8 leaves stage (to cover S, B, Mg, Mn, Mo demand)

Fertilisation program for sunflower, Yara Hungary

Foliar application of B

Crop specific foliar product

(Mg, S, B, Mn, Mo)



NPK 8-20-30 + te, 300 kg/ha

AN 100 – 160 kg/ha

Total nutrient rates applied, kg/ha:	
N	40 – 80
P_2O_5	60
K_2O	90
B	up to 400 g/ha

Summarizing recommendations for sunflower fertilisation management

- Nutrient supply focus at start of season
- Be careful with nitrogen
- B most critical trace element
- Higher S requirement than cereals
- Foliar applications responsive

About sugar beet fertilizer management

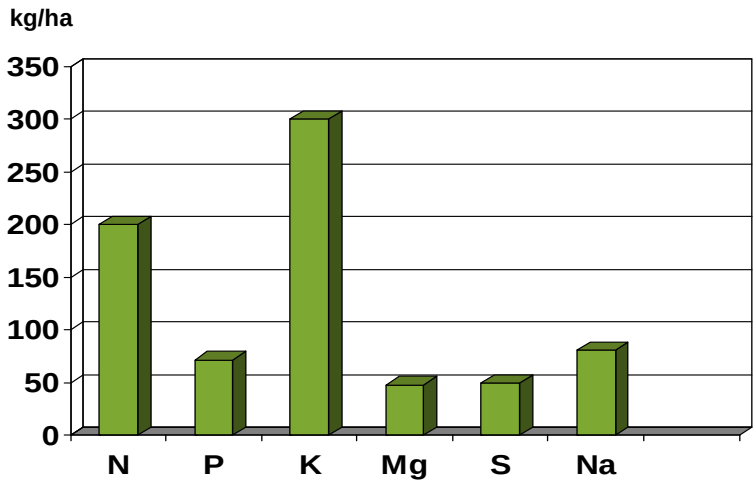
World‘s Top 15 countries in sugar beet acreage

Country	Area (1000 ha)	Country	Area (1000 ha)
1. Russian Fed	992	11. Egypt	104
2. Ukraine	577	12. Belarus	94
3. USA	504	13. Italy	85
4. Germany	403	14. **Belgium**	83
5. **France**	394	15. **Netherlands**	82
6. Turkey	299		
7. **Poland**	247		
8. China	216		
9. Iran	160		
10. **UK**	122		

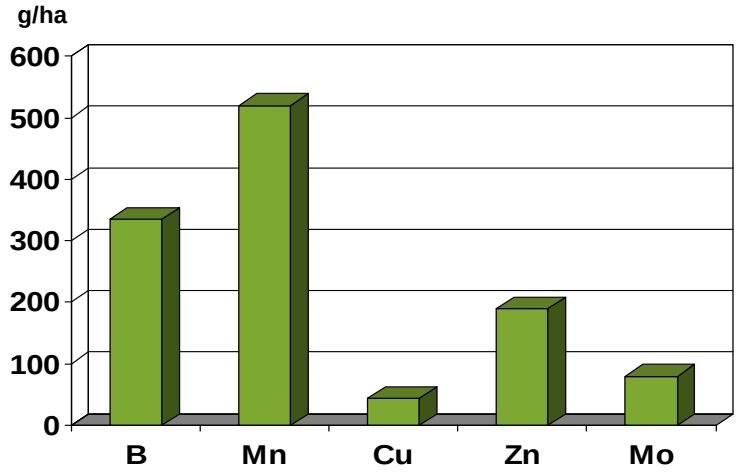
REF: FAO (2007)

Nutrient requirements of sugar beet

Macro and secondary nutrient uptake of sugar beet, kg/ha (in oxides, P_2O_5 etc.) at 40 t/ha yield level (average, various sources)



Average micronutrient uptake of sugar beet, tops and roots, g/ha (Draycott and Christenson, 2003)

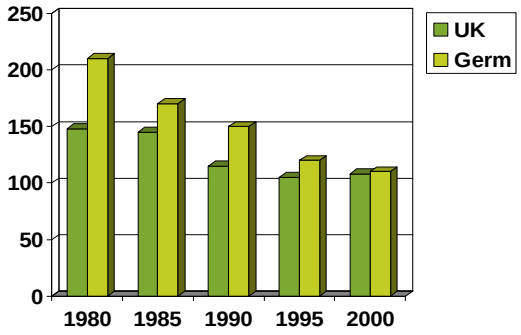


Trends in sugar beet fertilisation / Europe

Targets in sugar production

Yield	50 - 60 + t/ha
Sugar %	over 17
Amino-N, mg/ 100 g beet	below 18
K, me / 100 g beet	below 5
Na, me / 100 g beet	below 0,6
Extractability %	over 90

Use of fertiliser N for sugar beet, kg/ha in UK and Germany, 1980 – 2000 (Draycott et al. 2003, Märländer et al. 2003)



Main reasons for declining trend:

- more focus on beet quality
- balanced fertilisation
- environmental focus

NITROGEN (N) on sugar beet

- critical in season start - promoting rapid leaf development
  - target LAI (leaf area index) 3 as fast as possible
  - at LAI 3 the canopy can capture nearly all the sunlight energy
- rapid uptake during the first 60 days after emergence
- average uptake 2.5 kg/day/ha – peak 6 kg/day/ha
- total uptake around 200 kg N/ha

  - average N fertiliser rate around 100 kg /ha seems to be sufficient even at very high yield levels

Source: Draycott and Christenson 2003

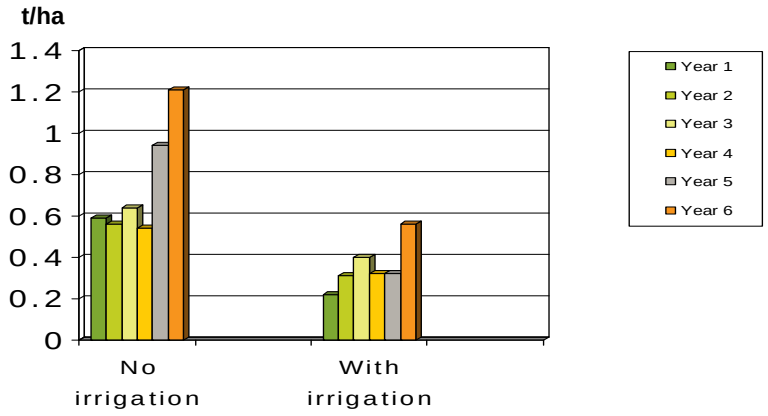
K fertiliser recommendations in some European countries when soil K class is medium

Country	Application rate, K_2O, kg/ha	Application time
Benelux	290 – 380	in autumn or winter as MOP
Denmark	180	to seedbed in spring
France	190	to seedbed in spring
Germany	290 – 380	in autumn or early spring (MOP) or to seedbed in spring as NPK
Poland	60 – 140 (with manure)	in autumn or to seedbed in spring
UK	75 – 100*	to seedbed in spring
	* maintenance	

Potassium (K) versus sodium (Na) for sugar beet

- Na reacts on sugar beet like plant nutrient, not as K substitute
- Na increases:
  - **leaf-area in early season**: increased use of solar radiation (this effect most important; Draycott and Christenson, 2003)
  - enhances crop's tolerance to water stress
  - higher sugar procentage and yield
- Therefore : Na fertilisation is recommended to soils low in Na

Increase of sugar yield by Na fertilisation



Largest responses to Na were achieved in seasons with little rain and when greatest responses to irrigation were obtained.

Source: Durrant et al. 1978

Micronutrient availability and soil pH

Nutrient	low pH	high pH	optimum pH
Manganese	+++	_ _ _	< 6,5
Boron	+	_	< 6,3
Zinc	+	_	< 6,5
Copper	+	_	5 - 7
Iron	+++	_ _ _	< 6,0
Molybdenum	-	+	> 5,5

Sugar beet is grown on soils with high pH and therefore micronutrient availability may cause nutritional disorders

Boron (B) and manganese (Mn), most critical micronutrients on sugar beet

Boron (B)

- important for maintenance of sugar transport in plants
- poorly mobile in plant, should be available through the whole season

Manganese (Mn)

- unique role in photosynthesis
- deficiencies on leaves as mottled areas between veins, not uncommon
- supply critical in early season

Good to remember about micronutrients !

- quantity needed by plants is ”micro”
- effect on yield and quality is ”MACRO”

Boron deficiency on sugar beet

Photo:
Yara Hanninhof

Manganese (Mn) deficiency on sugar beet

Photo:
L.Ristimäki

Example about sugar beet fertilisation: 1. UK

N	– 120 kg/ha
P_2O_5	50 – 100
K_2O	75 – 150
MgO	75 – 100
Na_2O	- 200
B	as foliar, based on soil analysis

- part of N (30 – 40 kg/ha) is applied in seedbed, the rest at 2 leave stage
- P, K and Na can be applied in autumn, but advised to be applied in spring at least on light soils

Source: MAFF RB209

Example 2: Scandinavia

- at sowing ***NPK 15 – 8 – 10 + B, Mn and 11% of Na_2O***
- fertiliser rate 530 – 800 kg /ha
- Sweden: lower rate if placement method is used
  - N rate 100 – 120 kg /ha if broadcast
  - N rate 80 – 100 if placement method used
- in most cases no other applications needed
- in high pH soils foliar Mn recommended in June

Summarizing recommendations for sugar beet fertilisation management

Photo: Alstedgaard, Denmark

- **All nutrients preferably in spring at least in light soils**
- **P, K and Na can be given in autumn in heavy soils**
- **B and Mn most critical trace elements**
- **Placement fertilisation method if possible**
- **Early sowing and late harvesting**

Sugar beet harvesting in Tatarstan, Russia

Photo
L. Ristimäki
2005