PROAGRO LECTORIUM

Micronutrients and their role in cultivation of major crops

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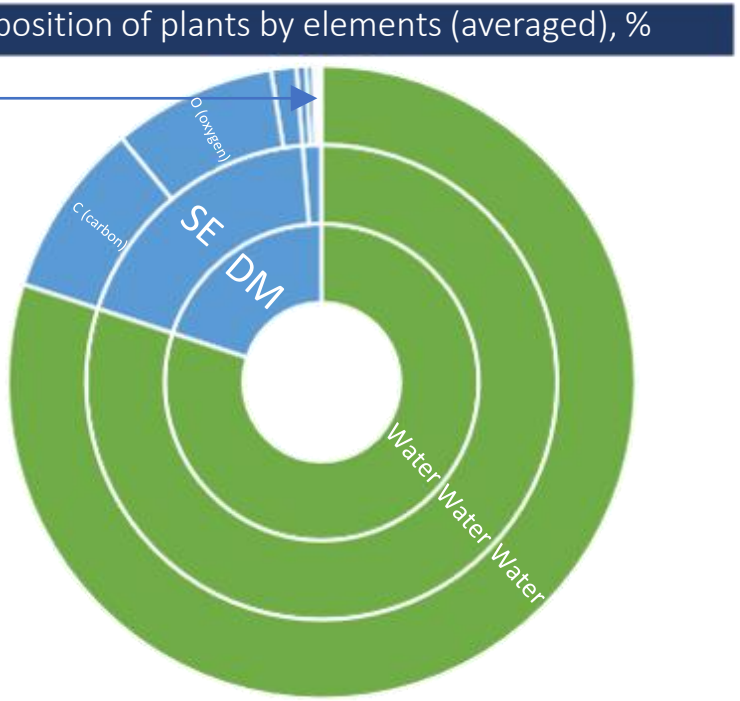
Significance of micronutrients (MNs)

MN

The main and most important role is to increase the efficiency of basic mineral fertilizers



Classification of MNs

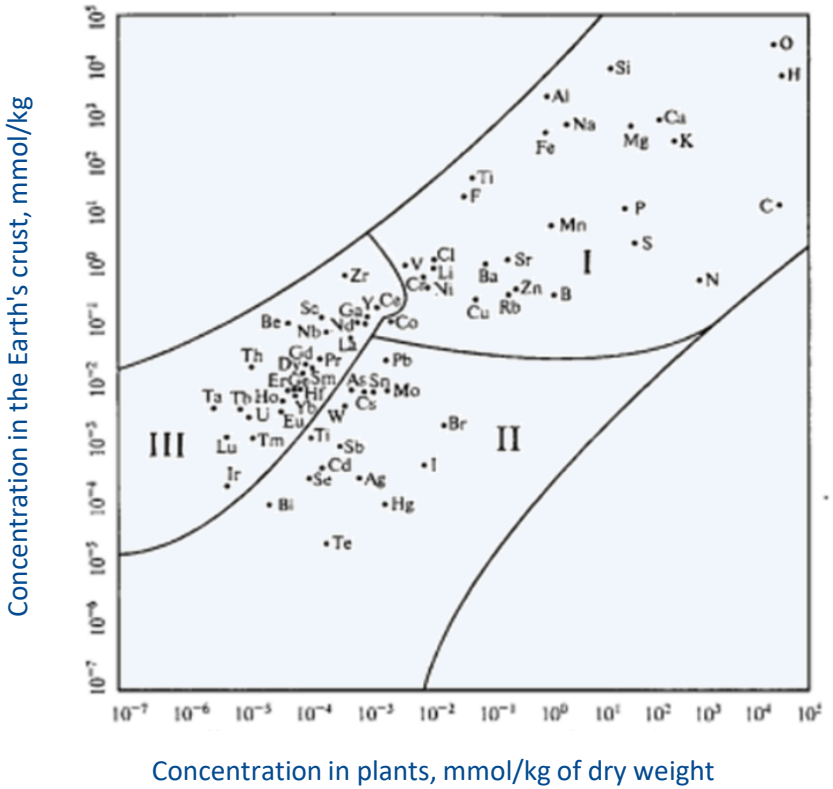
Essential

I — So that the life cycle of the plant is complete

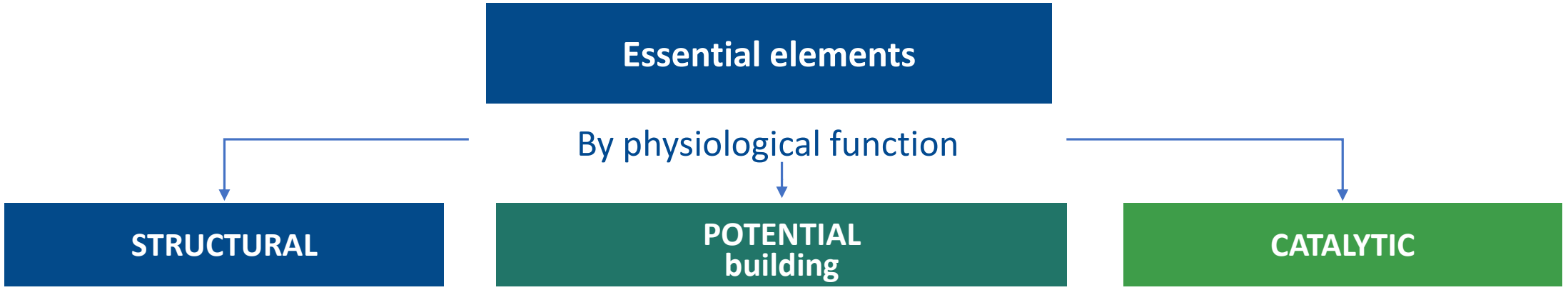
II — Physiological functions performed with the participation of the element cannot be carried out when it is replaced by another element

III — The element must be directly involved in the metabolism of the plant (Arnon and Stout, 1939).

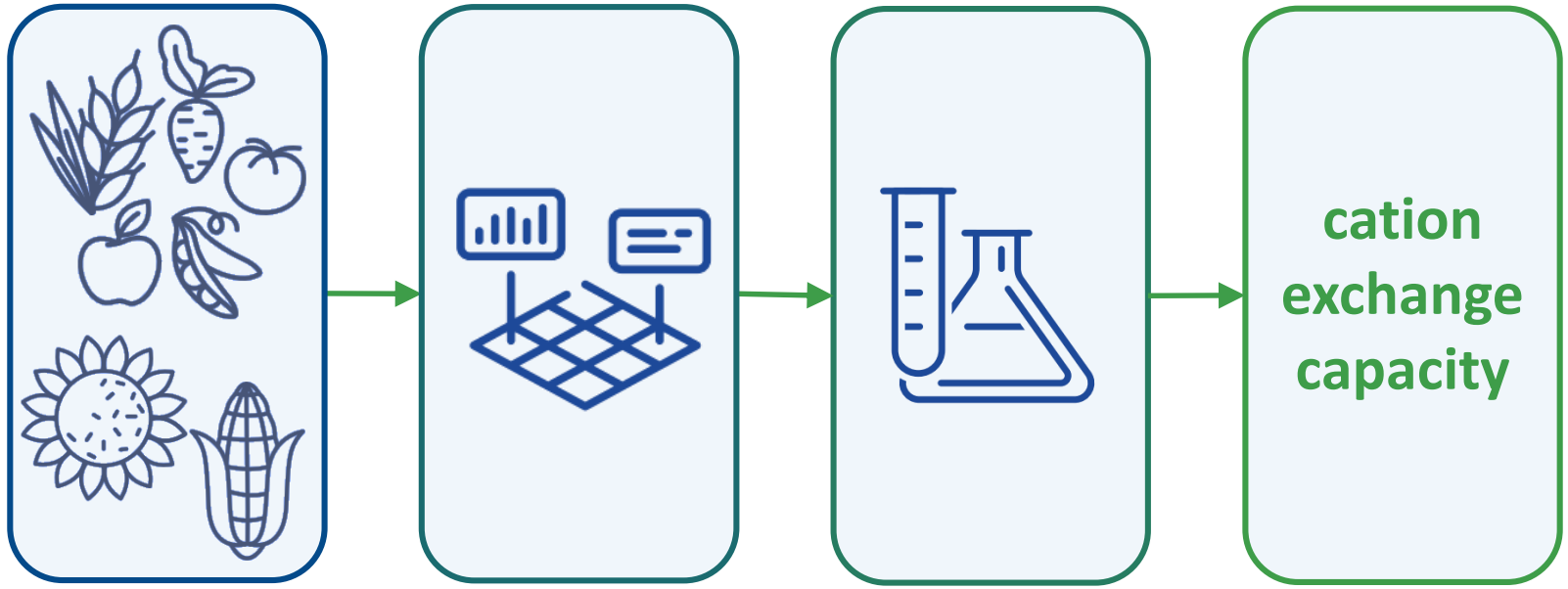
Useful



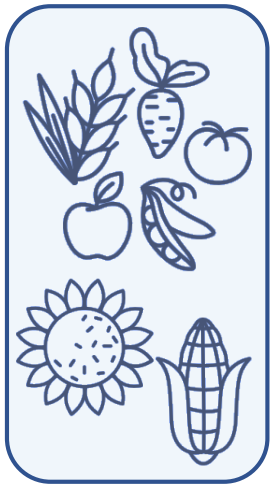
Classification of MNs



Factors of MN entry into plants



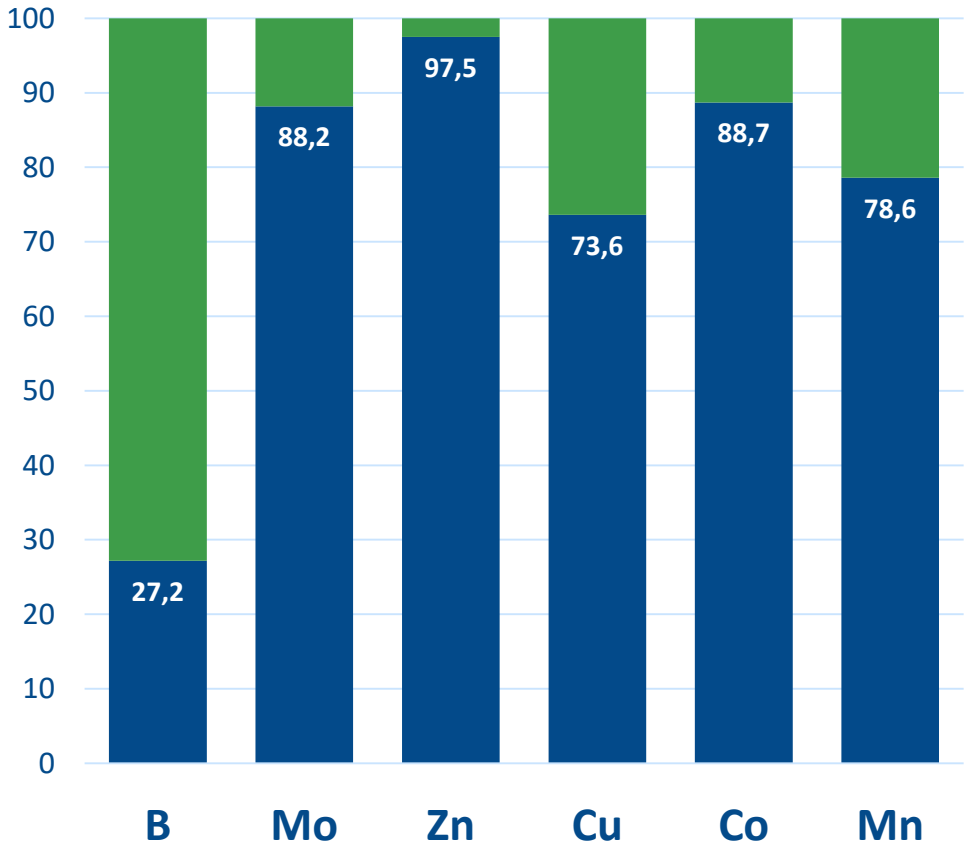
Sensitivity to MN deficiency



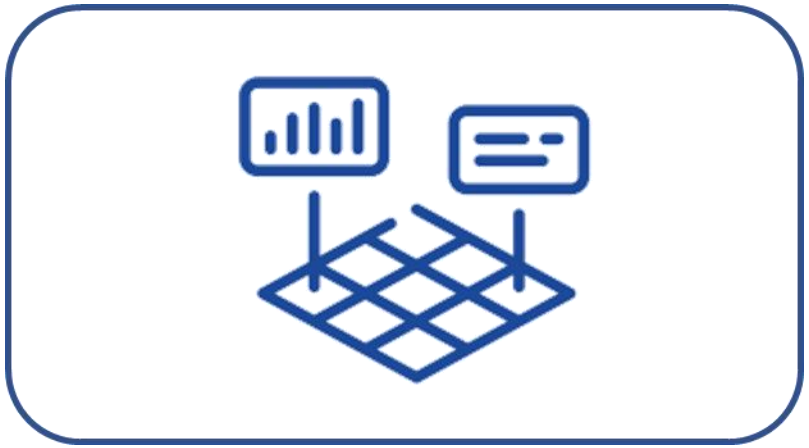
	B	Cu	Fe	Mn	Mo	Zn
Beans	H	H	B	B	C	B
Broccoli	B			C	C	
Cabbage	B	C	C	C	B	
Carrots	C	B		C	H	H
Salad	C			C	C	
Potato	H	H		B	H	C
Tomato	B	C	B	C	C	B

	B	Cu	Fe	Mn	Mo	Zn
Barley	H	B	B	C	H	C
Maize	C	C	C	H	H	B
Oats	H	B	C	B	C	H
Rice	H	B	C	C	H	C
Rye	H	H	H	H	H	H
Sorghum	H	C	B	B	H	B
Wheat	B	B	C	B	H	C

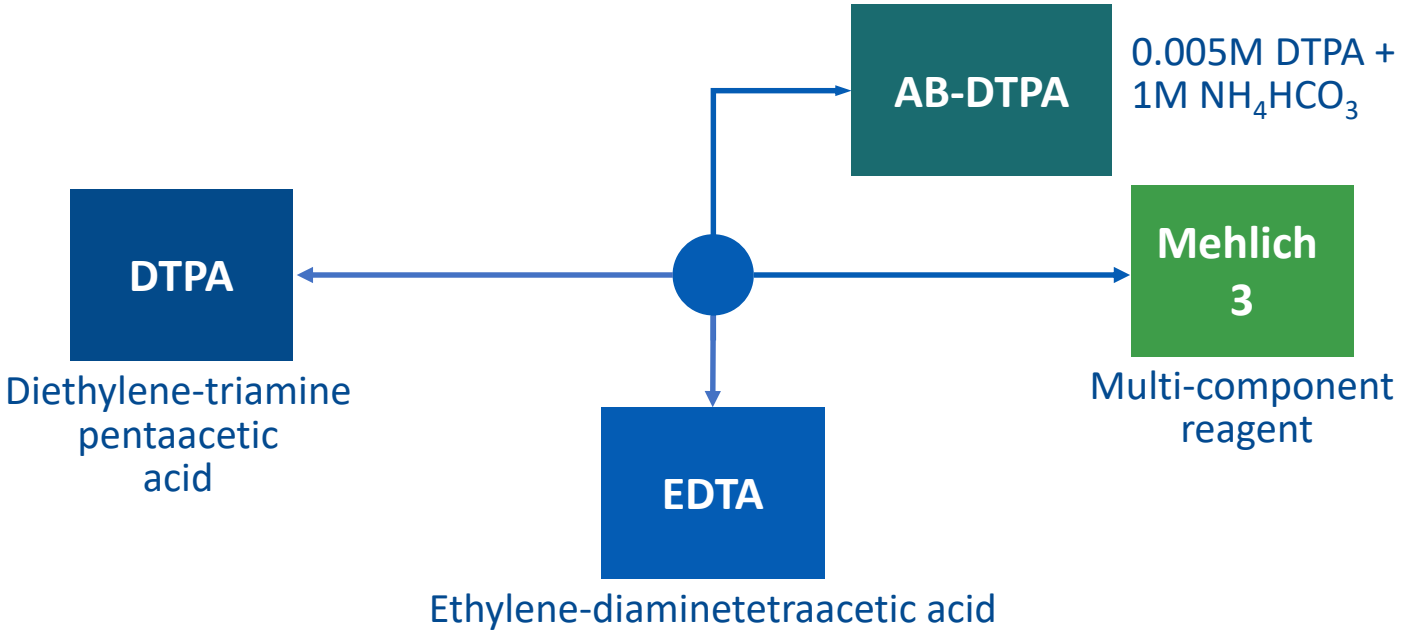
Soils in RF



Proportion of total soil areas on which microfertilizers should be applied



Determination of MNs in soil



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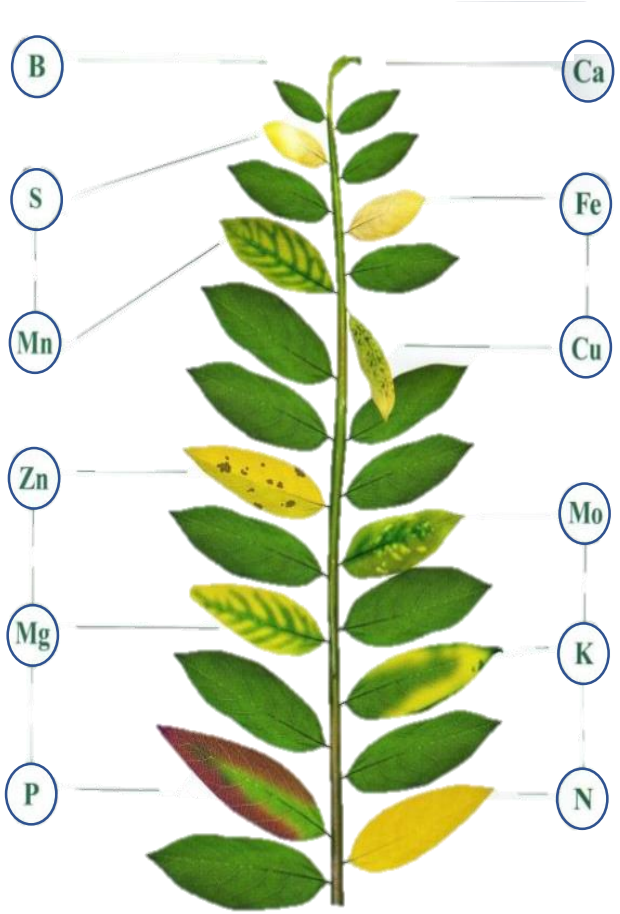


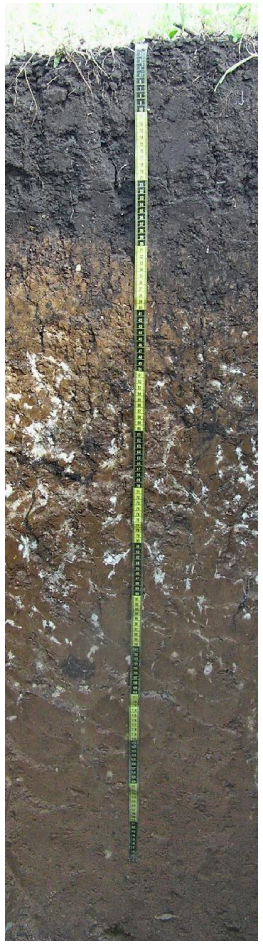
Agricultural crop

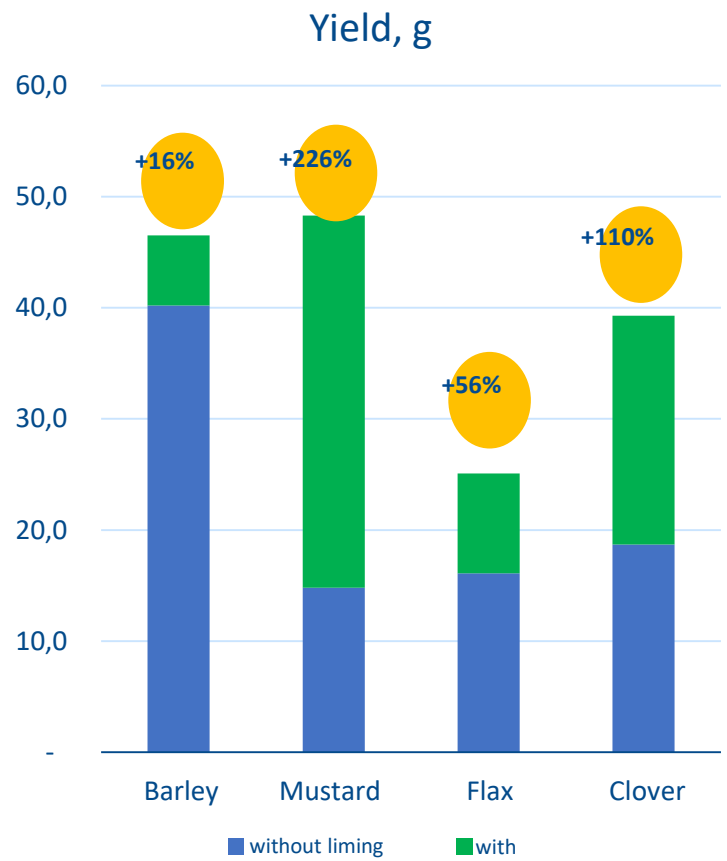
Humus/OM, grain size distribution, MN content level

Preventive MN application

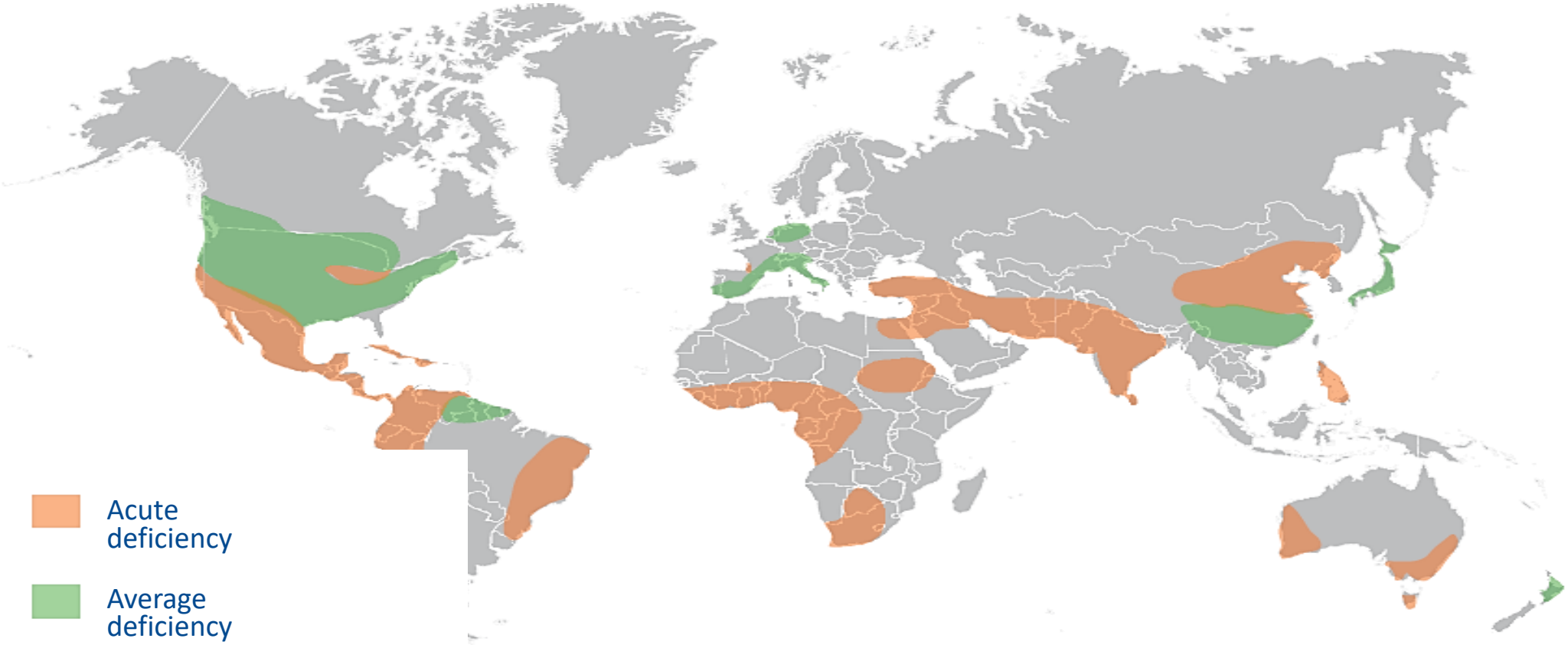
Zinc

Calcareous chernozem





Regional zinc deficiency



Sources: Argus, IFA

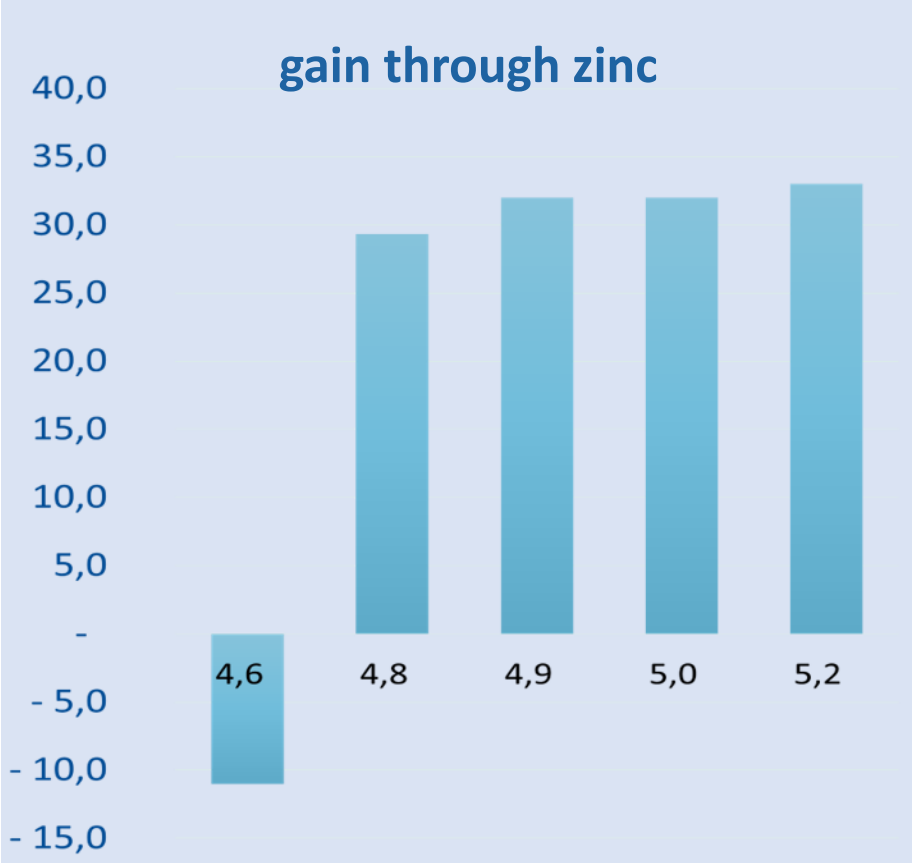
Application of NPK with zinc and yield growth (China)

Crop	Number of experiments	Yield growth (range)
Rice	66	6.4%–17.8%
Wheat	118	8.2%–15.6%
Maize	104	7.7%–21.1%
Apple trees	52	14.5%–41.3%

Zinc by NPK background, Moscow region

- Acidity
- Humus content
- Phosphorus content
- Potassium content

Significance of soil indicator on the effectiveness of zinc to soil



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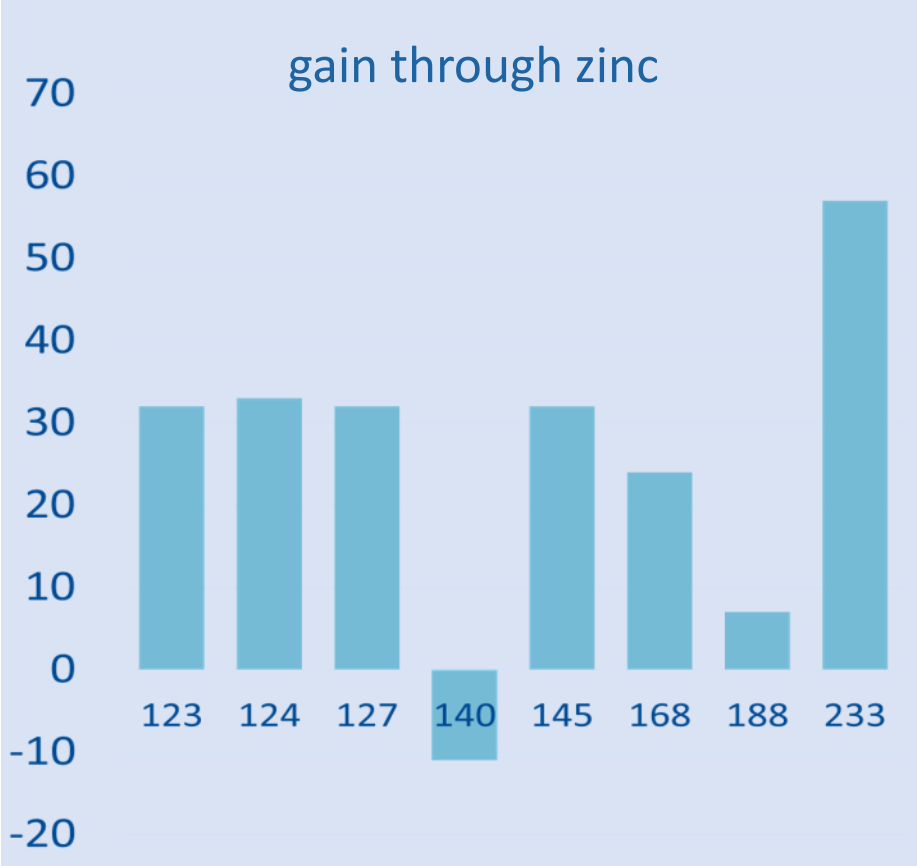
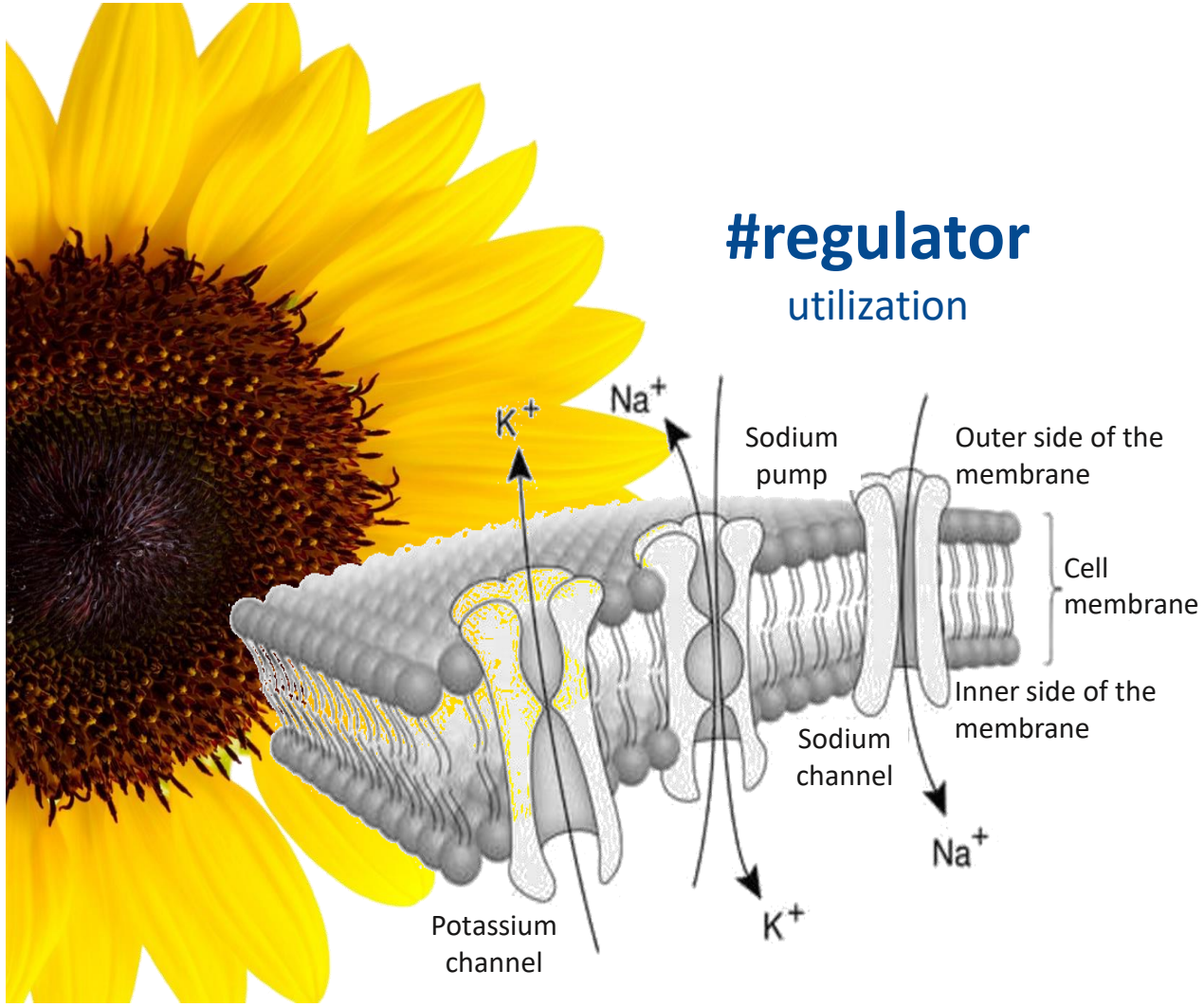
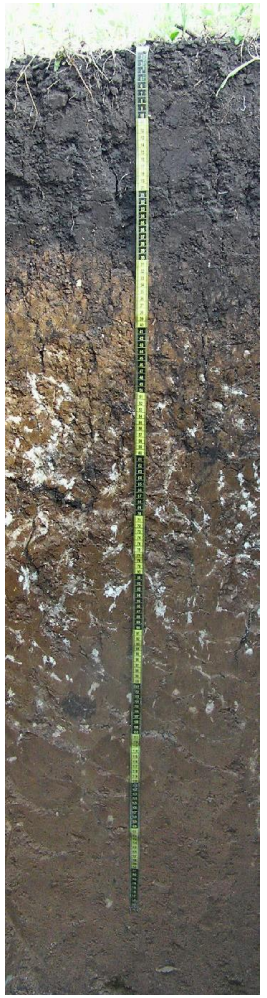
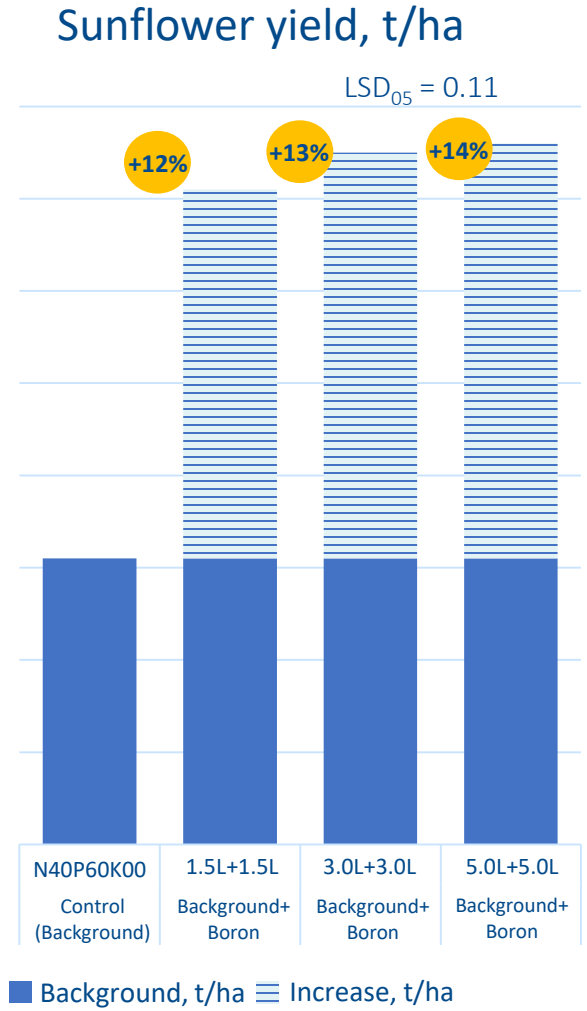


Boron


#regulator
utilization
K+
Na+
Sodium pump
Outer side of the membrane
Cell membrane
Inner side of the membrane
Sodium channel
Na+
K+
Potassium channel

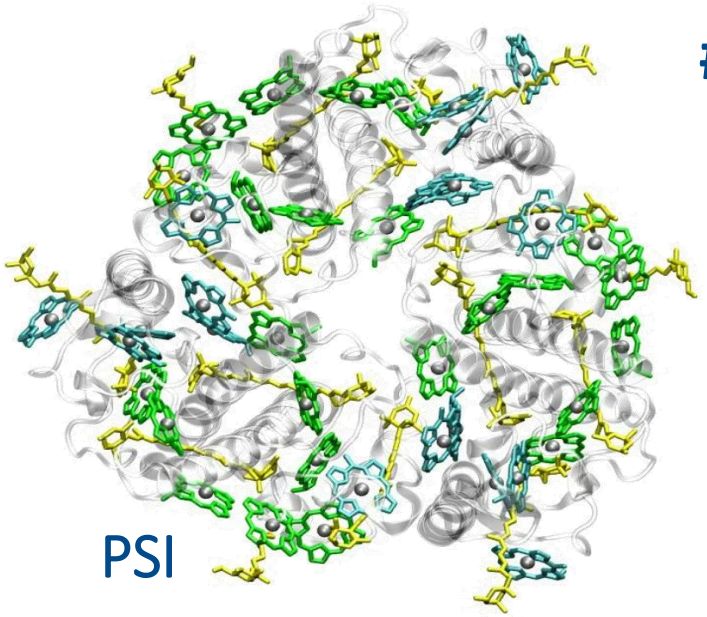

Calcareous chernozem


Sunflower yield, t/ha
LSD05 = 0.11
3,80
3,70
3,60
3,50
3,40
3,30
3,20
3,10
3,00
+12%
+13%
+14%
N40P60K00
Control (Background)
1.5L+1.5L
Background+ Boron
3.0L+3.0L
Background+ Boron
5.0L+5.0L
Background+ Boron
Background, t/ha
Increase, t/ha

Application of urea with boron

Crop	Number of experiments	Area, ha	Yield growth (range)	Yield growth (average)
Rice	20	125	5.0%–15.7%	9.6%
Maize	46	39	6.5%–22.1%	13.8%
Wheat	16	44	11.0%–18.3%	12.7%
Soybean	2	7	19.3%–20.0%	19.4%
Sugar beet	2	1	12.5%–16.1%	13.4%
Total/average	**86**	**216**	**5.0%–22.1%**	**13.8%**

Copper

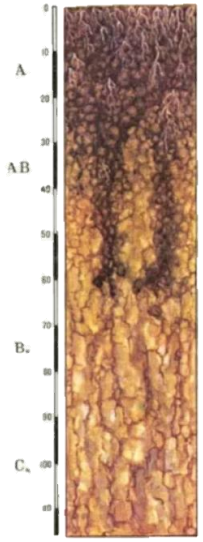


PSI

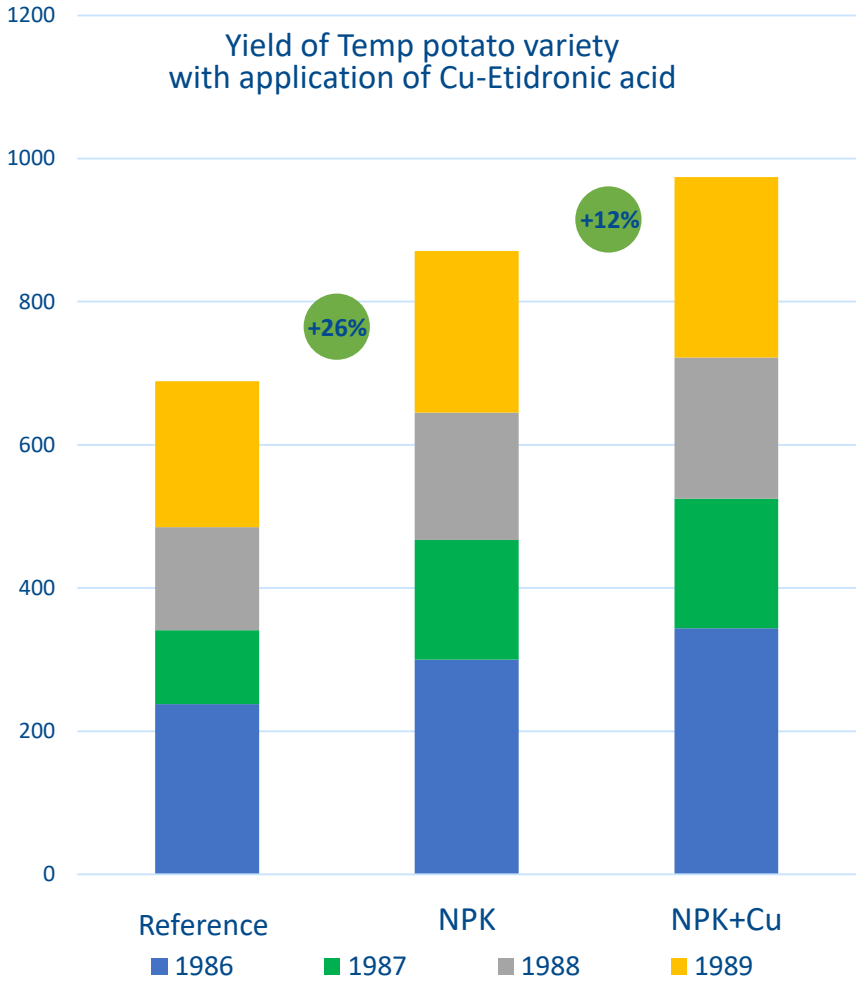
#accelerator

Accumulation

Protection



Low copper content (1.5–3.0 mg/kg) is observed in the soils of most regions of Central Russia and the North Caucasus.



Polyphenol oxidase | Plastocyanine

Lactase | Ascorbic acid oxidase

Metabolism

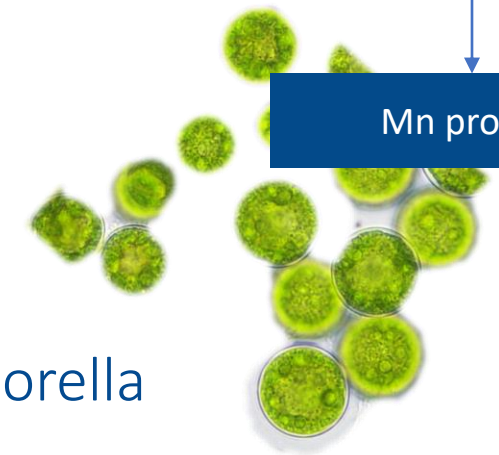
Molybdenum

#catalyst

- Xanthine oxidase
- Dehydrogenase
- Nitrogenase
- Aldehyde oxidase
- Sulfate reductase
- Aldehyde oxidase

Molybdenum deficiency is found on acidic sod-podzolic and light-gray forest soils, where it passes into forms that are not absorbed by plants due to the increased content of mobile aluminum, iron and manganese. Sometimes, toxic effect of molybdenum on plants is also manifested in alkaline soils due to increased content of mobile forms of this element.

Manganese



chlorella

Mn1

Plants → tannins

Plants → alkaloids

Arginase

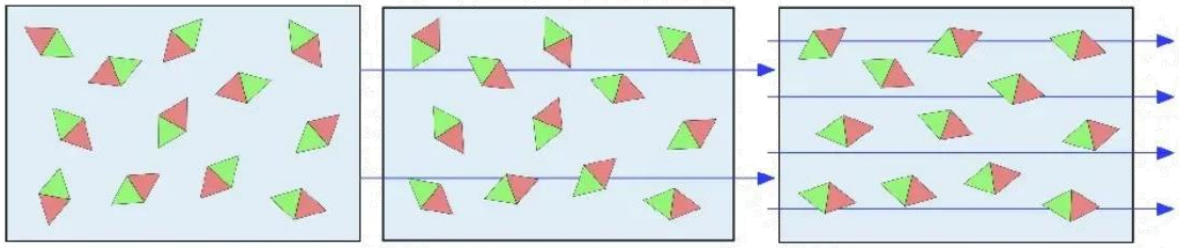
RNA polymerase

Nitrogen metabolism

Mn protein

Superoxide dismutase

Elimination of superoxide radical toxicity



Paramagnet in the absence of a magnetic field.

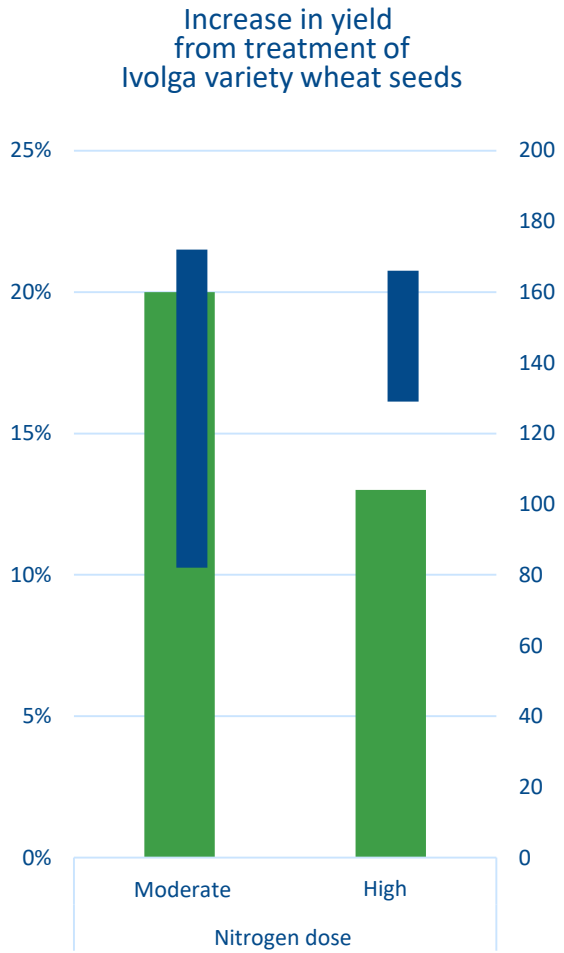
Paramagnet in the presence of a weak magnitude zero.

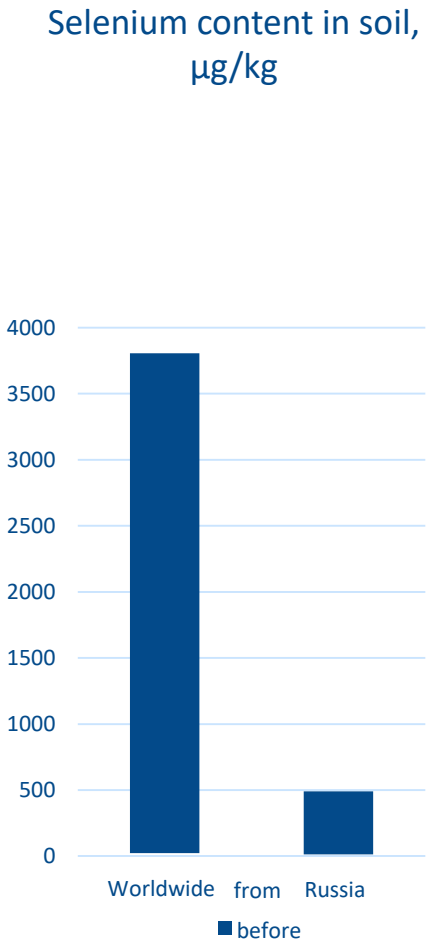
Paramagnet in the presence of a strong magnetic field.

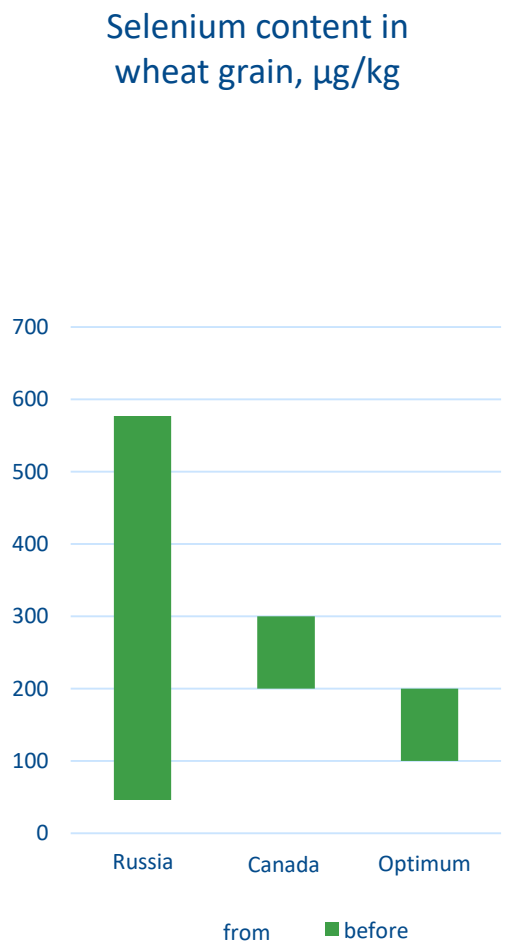
Selenium

- UltraMN antagonist for mercury and arsenic
- UltraMN deficiency provokes cardiomyopathy and tubular bone changes

selenates
selenites







Tasks solved by fertilizers with MNs

Increased sugar

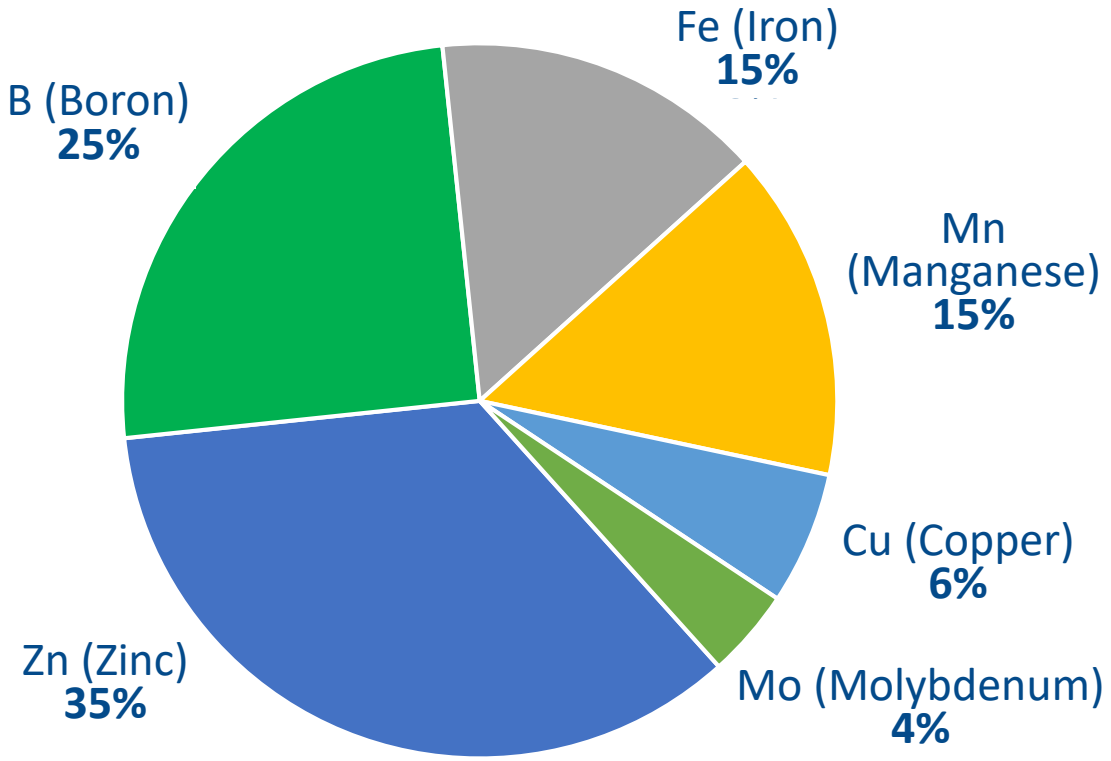
Increased protein production

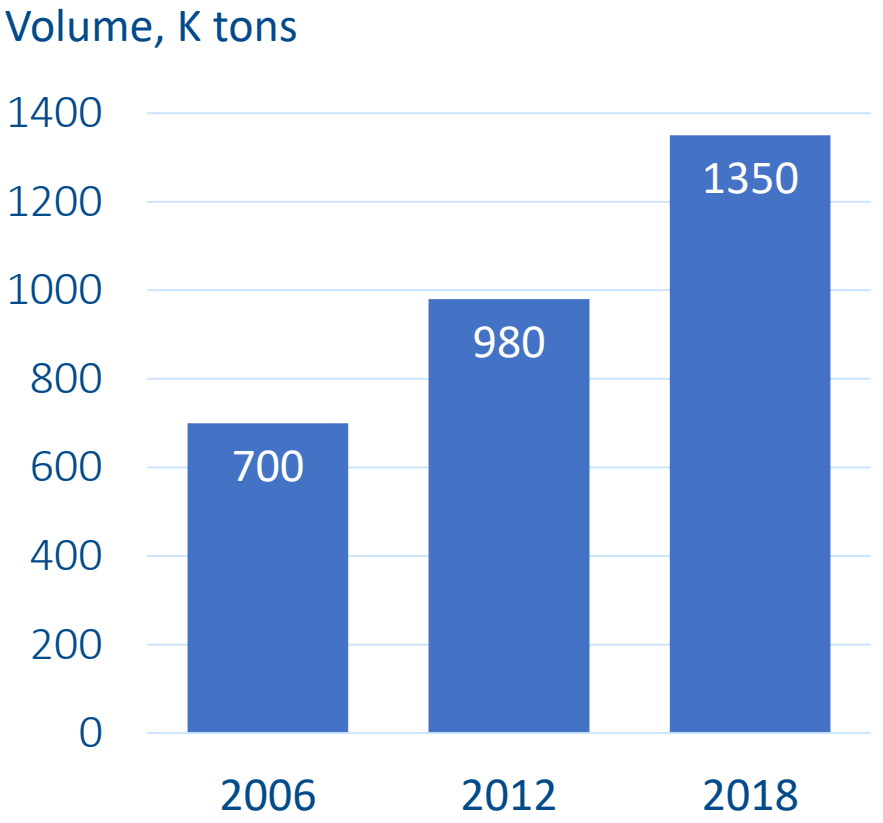
increased yield by 10–15%

Improved quality of fodder and vegetables

Cultivation of cold-, drought- and disease-resistant varieties

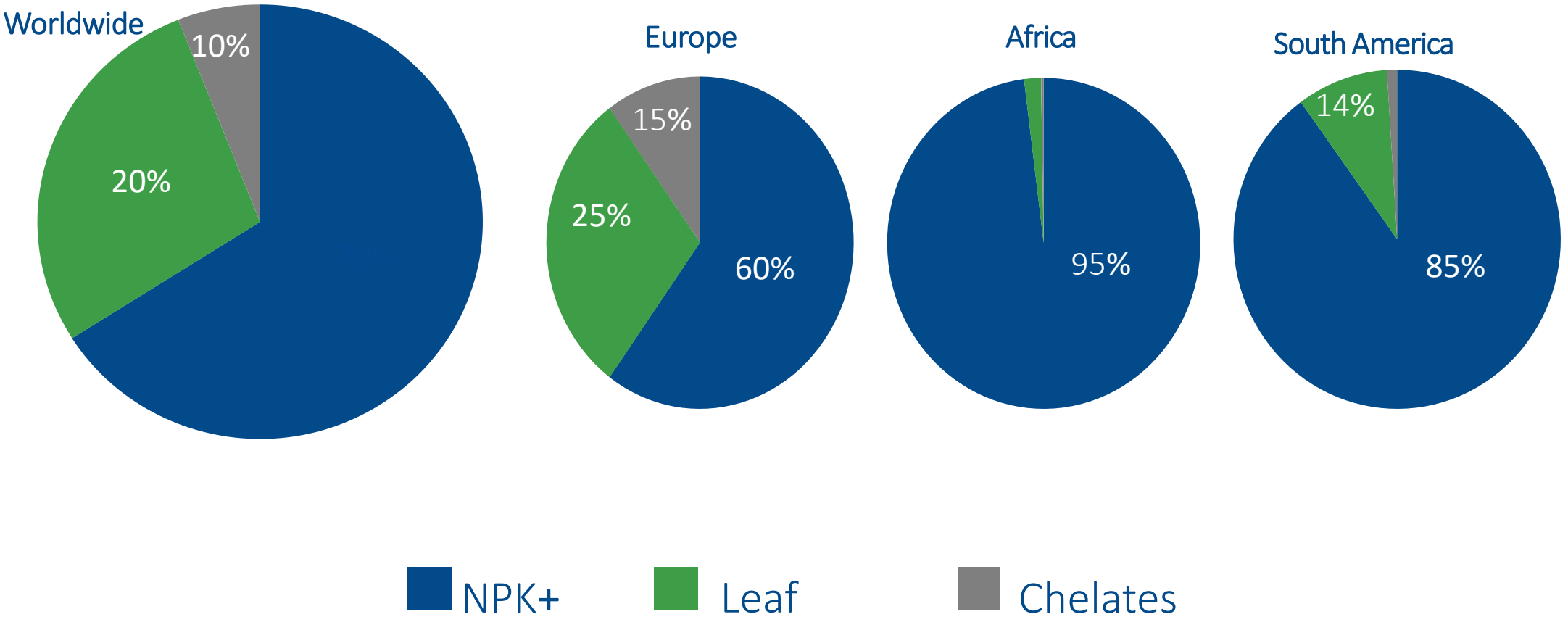
Global MN fertilizer market assessment





Sources: Argus

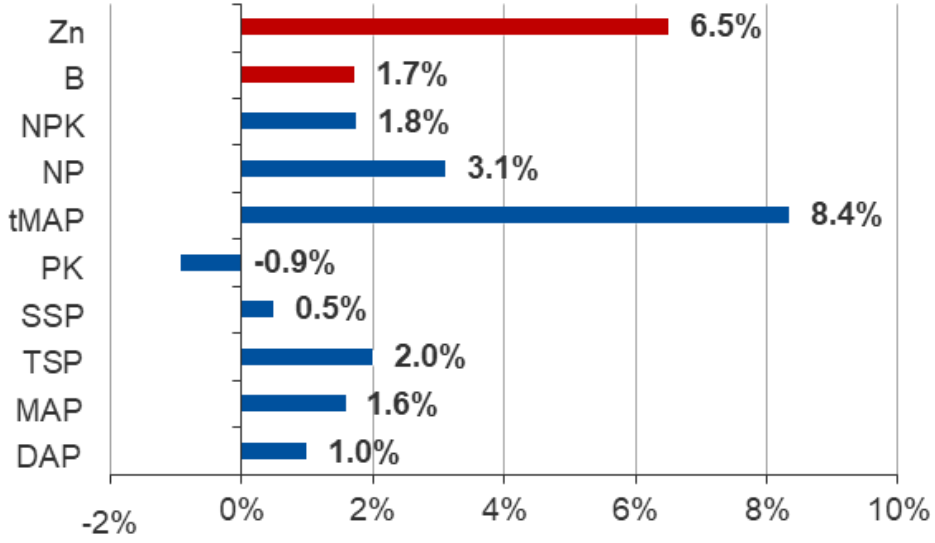
Global MN use by product type

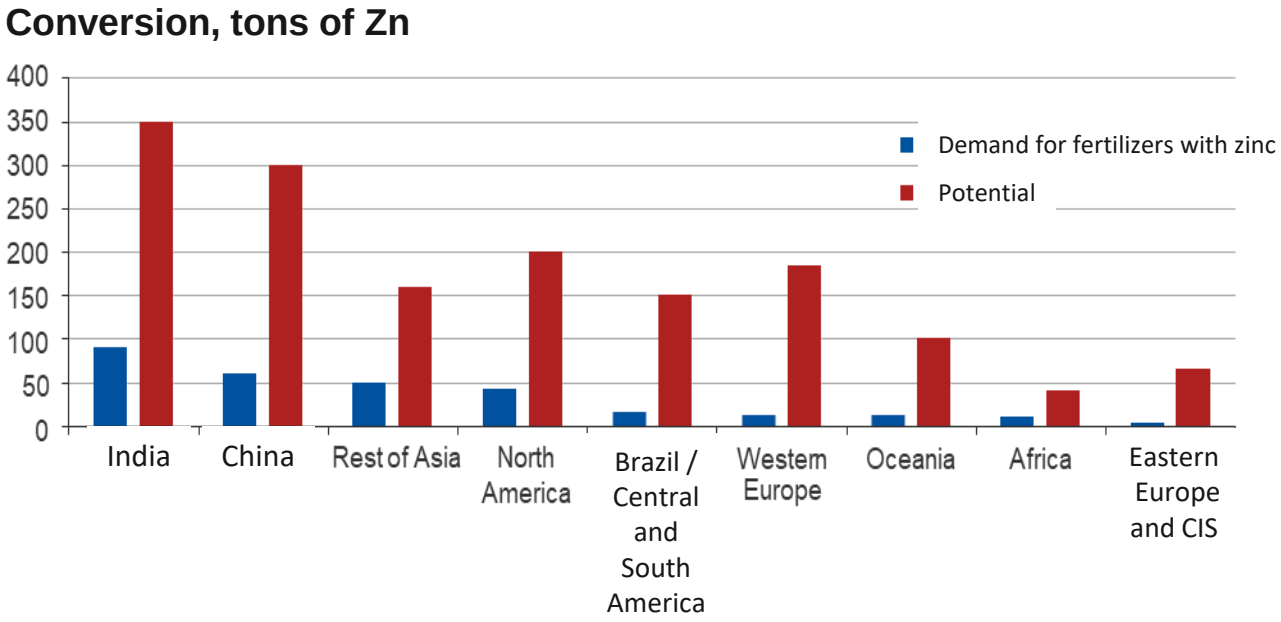


Sources: Argus

Main drivers of zinc fertilizer application

Consumption growth forecast, CAGR 2018–2030





Sources: Argus

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