

Sustainable application of compost and biogas residues in agriculture



Dr. Agr. Ing. Mokry, Markus
LTZ Augustenberg, Karlsruhe

Data basis

Compost:

Bundesgütegemeinschaft Kompost e.V., aktuelle Daten der Gütesicherung nach RAL-Gütezeichen 251

→ ca. 5.700 compost samples

Biogas residues:

LTZ Augustenberg, aktuelle Übersichtsuntersuchung an Biogasanlagen in Baden-Württemberg

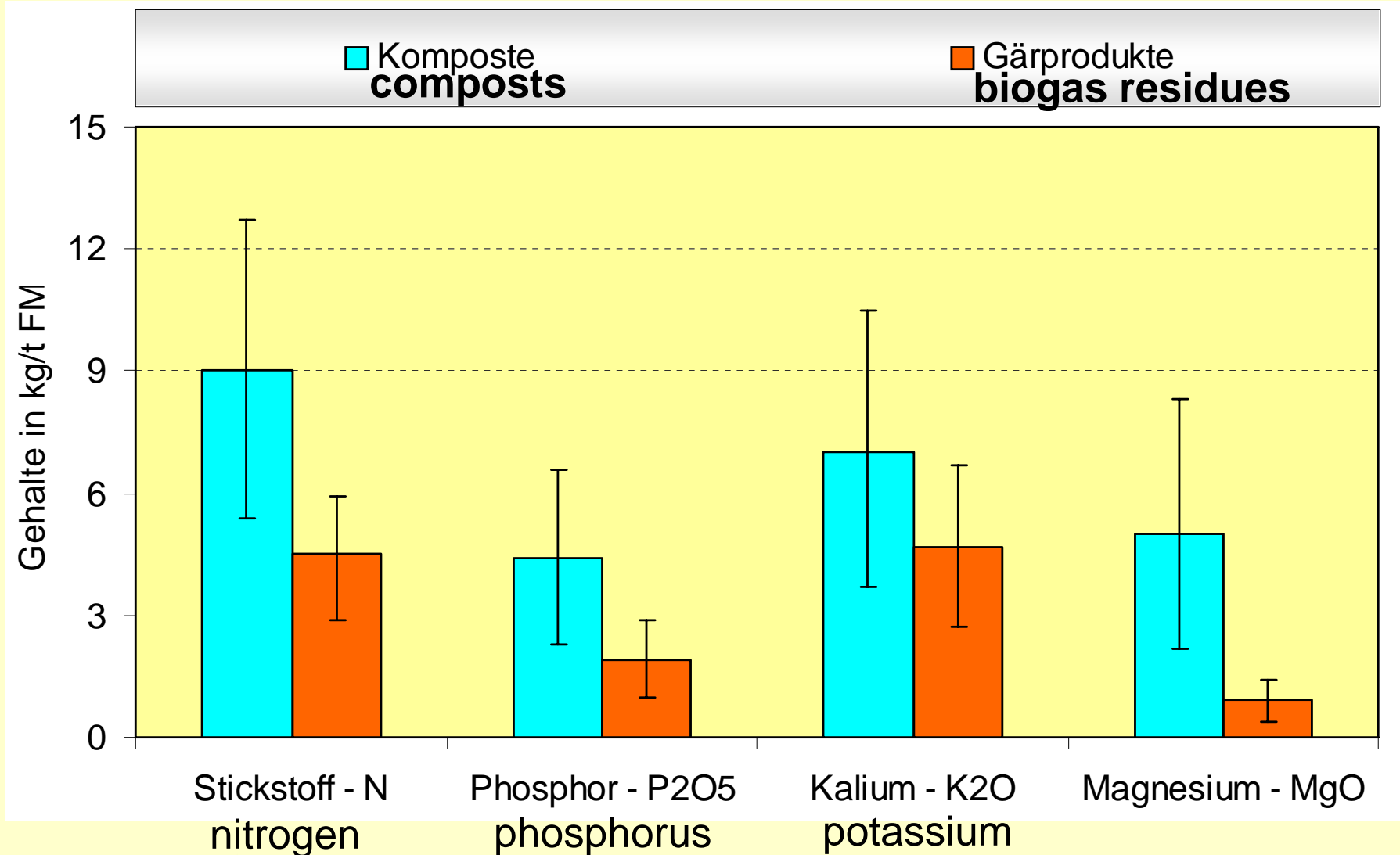
→ ca. 250 biogas residue samples

Results of analysis

- **Nutrients:**

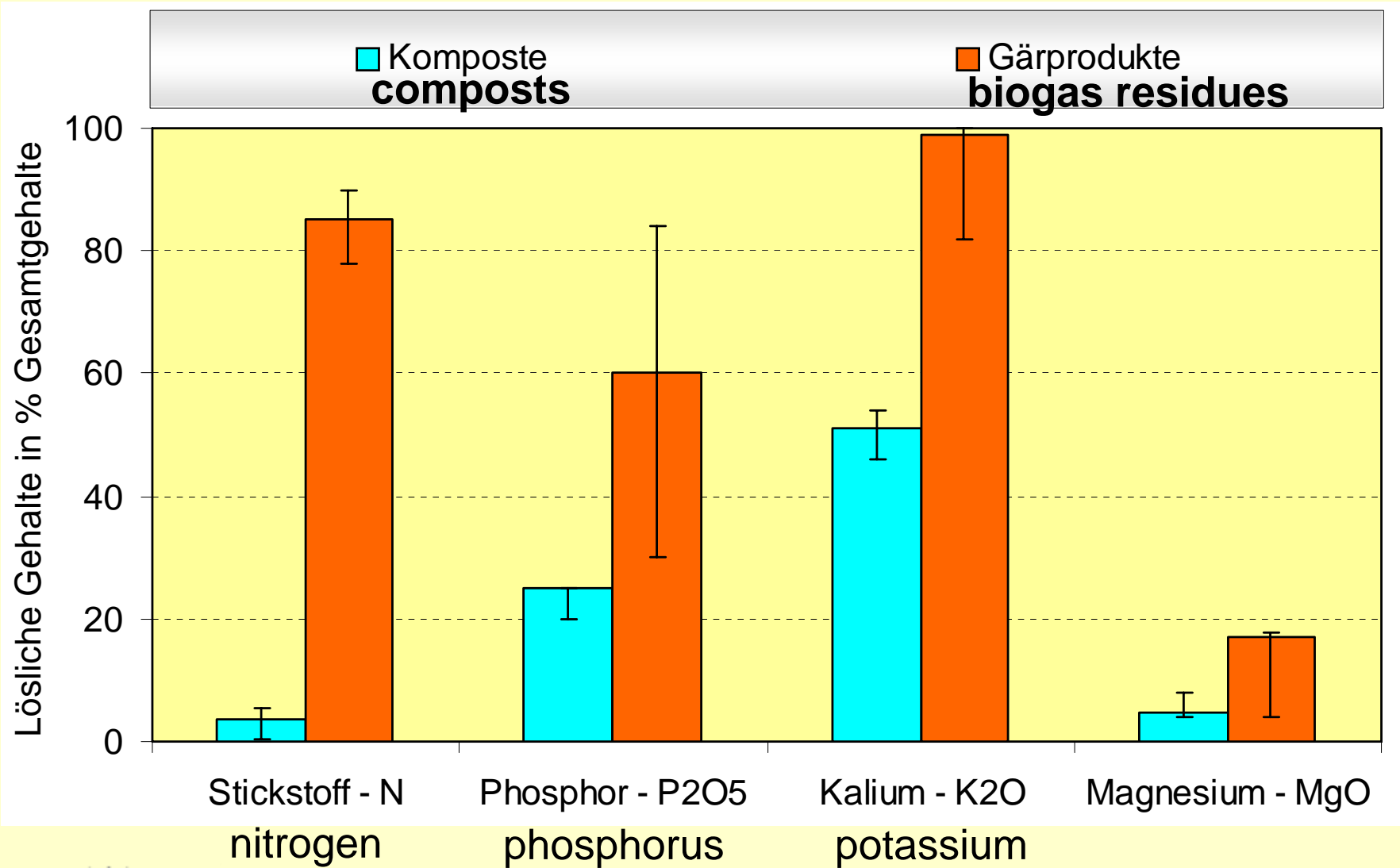
- total content of nutrients (N, P, K, Mg)
- soluble nutrients (Nitrat, Ammonium, P, K, Mg)

total content of nutrients



soluble content of nutrients

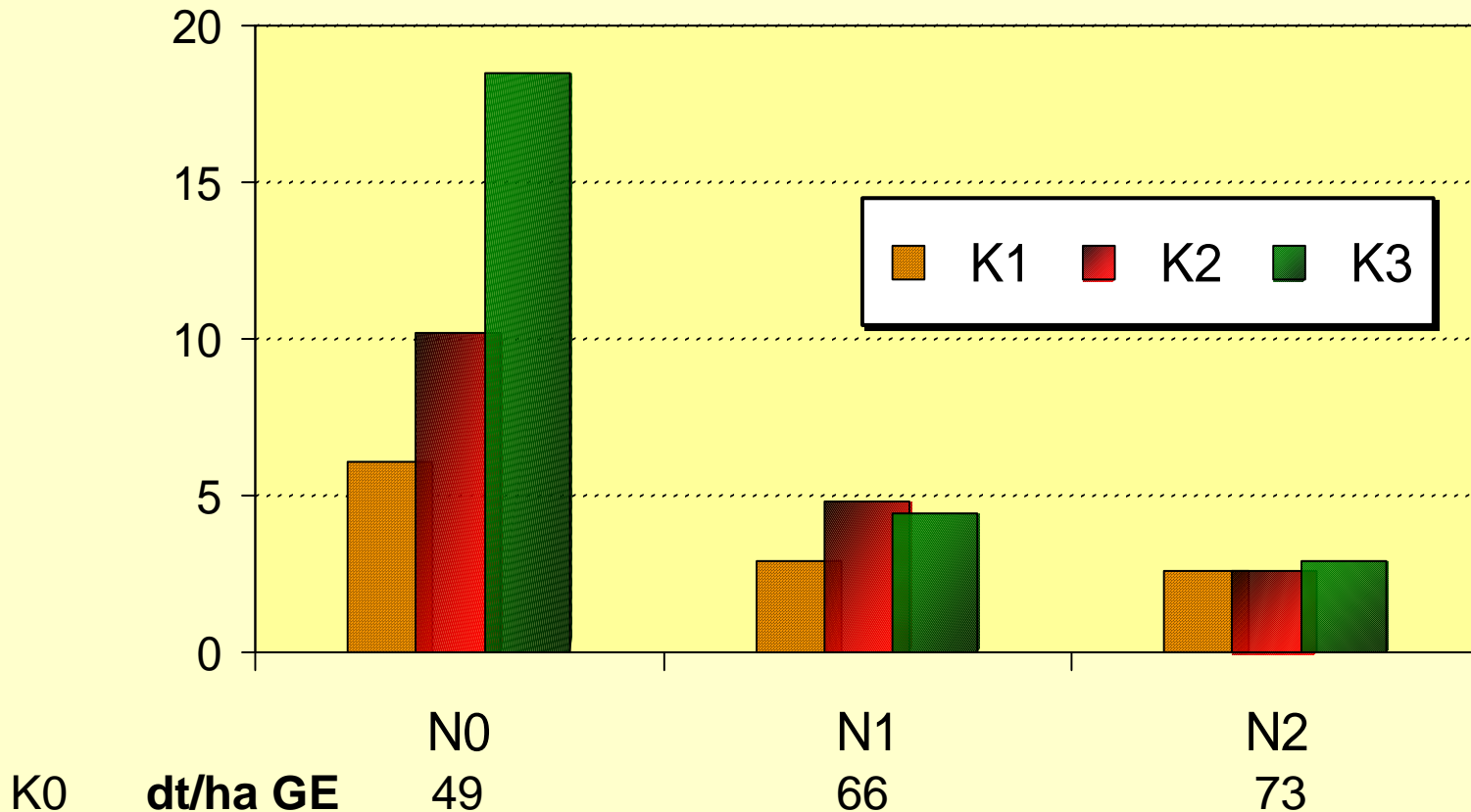
[relative to the total content]



Corn yield with compost-fertilisation

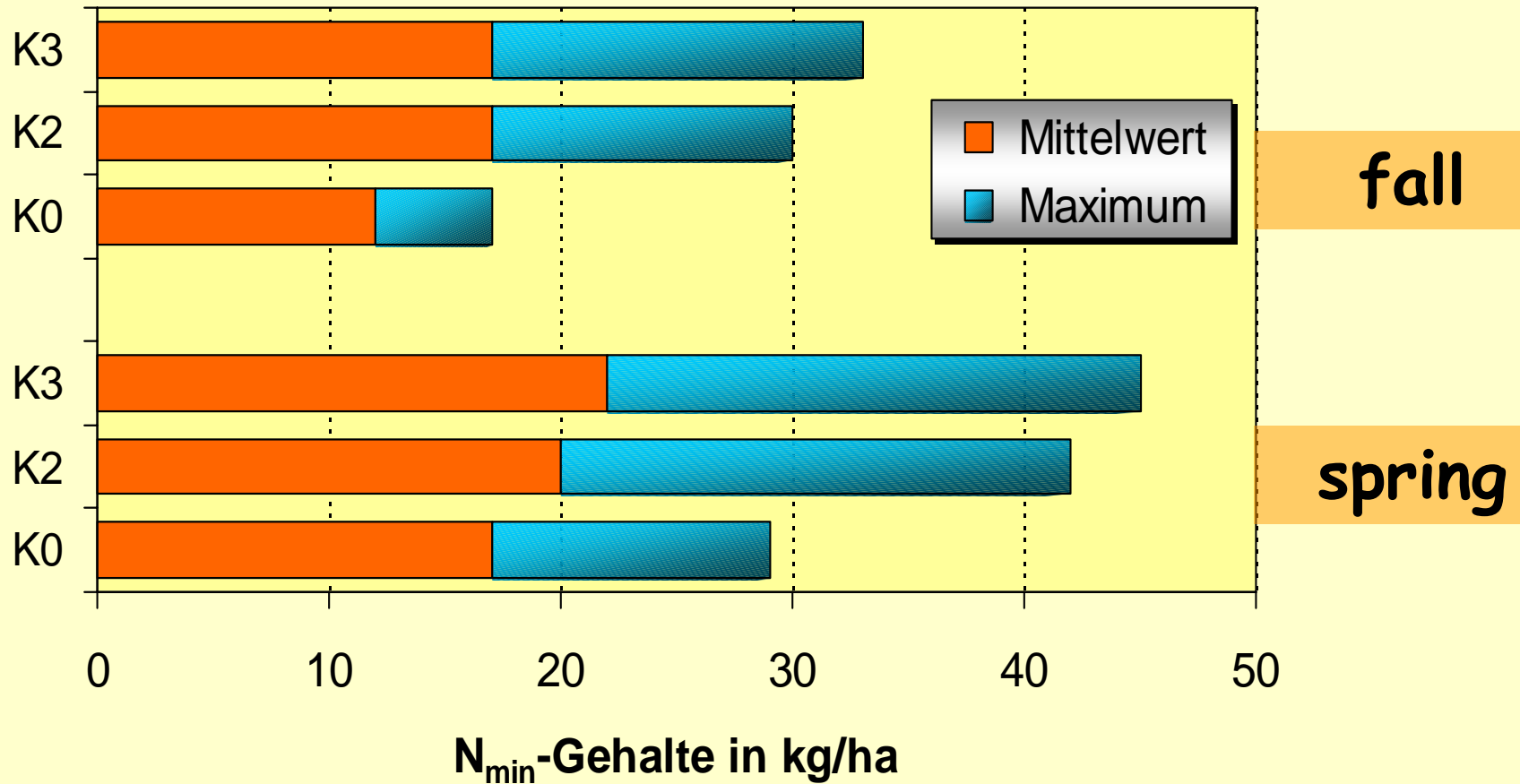
[relative to the variant without compost-fertilisation]

- average of 6 sites and years (1995-2000) -



Content of nitrate-N in soil

- 3rd year of **compost** application; optimum mineral N-fertilisation -



Soil contents of P- and K balance sheet of input and output

Results of field trials with **compost** in Baden-Württemberg:

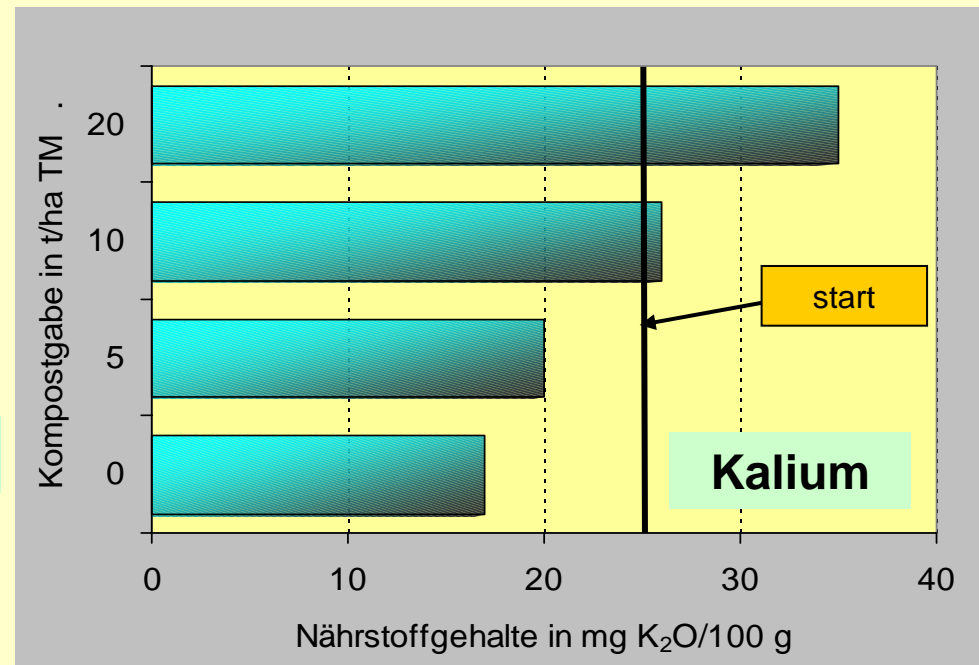
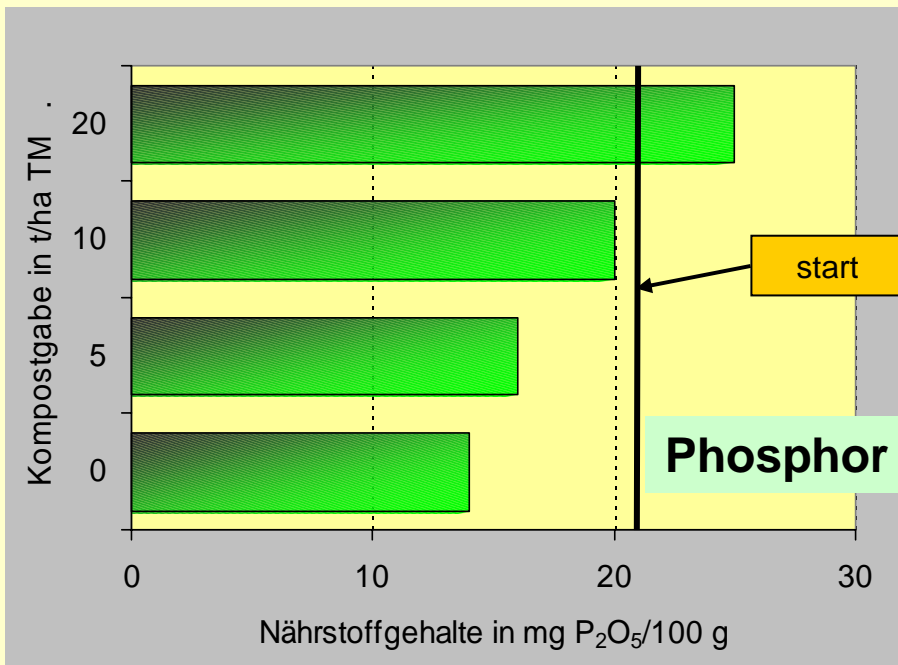
Trend of the soluble nutrients in the soil (average after 9 and 12 years)

Average input (kg/ha) with compost (6 – 7 t/ha DM yearly)

$P_2O_5 = 40 - 50$

$K_2O = 60 - 80$

$MgO = 45 - 60$



Conclusion - nutrient effects

compost

biogas residues

nitrogen

Low fertilizing effect

- minimal solubility → only 3 - 5 % utilizable yearly
- large C/N-ratio (3/1 - 20/1) → slow N-mineralization

High fertilizing effect

- high solubility → **N-availability** similar to slurry
- utilizable nitrogen: 60 - 80 % of total N
- **However:** high risk of NH_3 -losses (pH!)

phosphorus, potassium, magnesium

Good P-, K fertilizing effect

- medium solubility and good mineralization
- input is fully effective within one crop rotation

High P-, K fertilizing effects

- solubility higher than of composts
- **input is fully effective similar to slurry**

Results of analysis

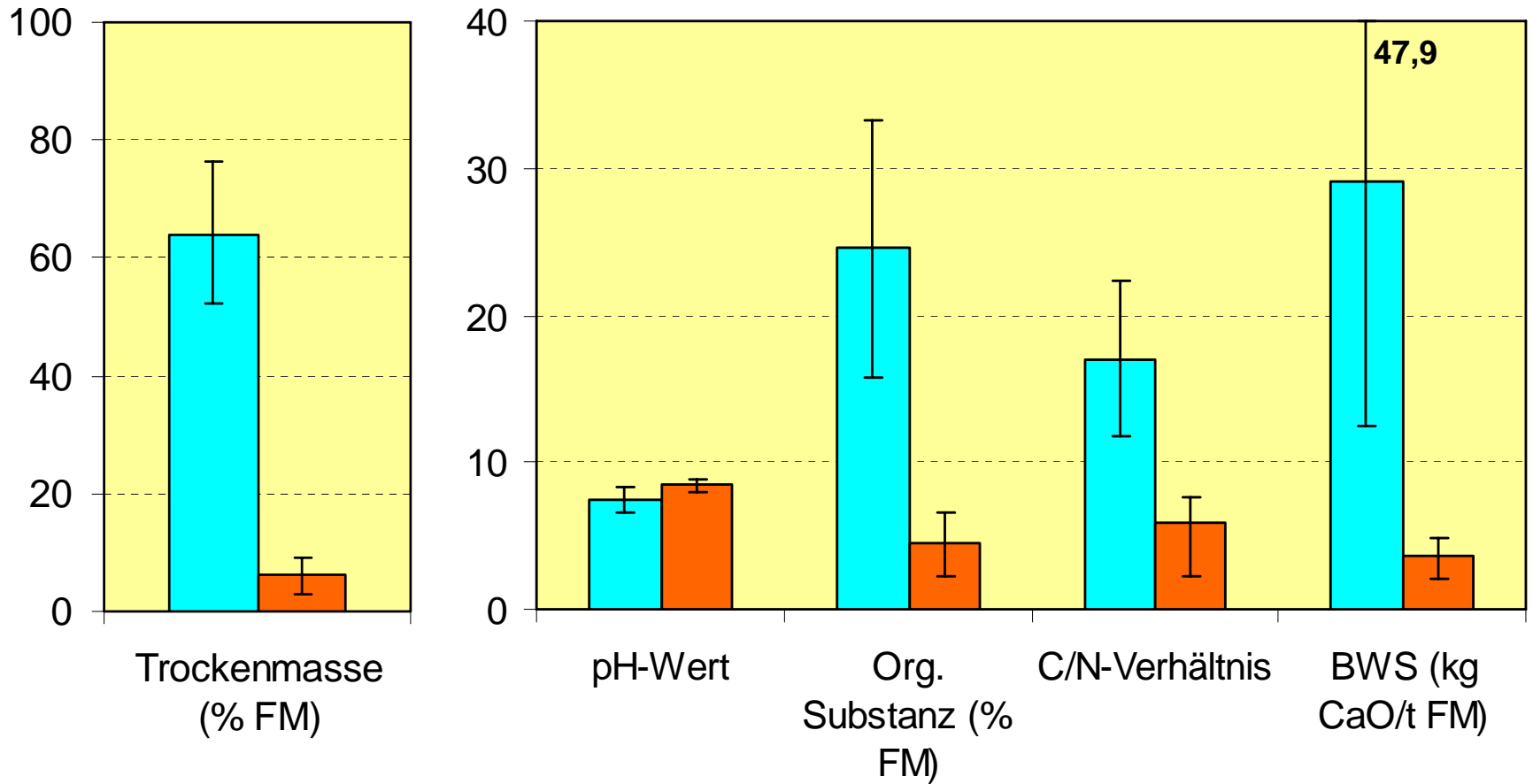
- **Nutrients:**

- total content of nutrients (N, P, K, Mg)
- soluble nutrients (Nitrat, Ammonium, P, K, Mg)

- **General parameters:**

organic matter, base active matter, C/N-ratio
lime status and pH value

General parameters



Trockenmasse (% FM)

pH-Wert

Org. Substanz (% FM)

C/N-Verhältnis

BWS (kg CaO/t FM)

dry matter

pH value

organic matter

C/N ratio

base active matter



Soil organic substance – humus balance

[in theory]

Supply of compost (every 3 years)		20 t DM/ha	30 t DM/ha
Organic matter	t/ha DM	2,4 - 2,8	3,6 - 4,0
Carbon total	t/ha	1,3 - 1,7	2,0 - 2,4
there of C reproducible	t/ha	0,6 - 0,9	1,0 - 1,3
Humus demand of soil		medium	high
Humus content of soil	optimal	0,2 - 0,4	0,6 - 0,9
	suboptimal	0,4 - 0,6	1,2 - 1,6

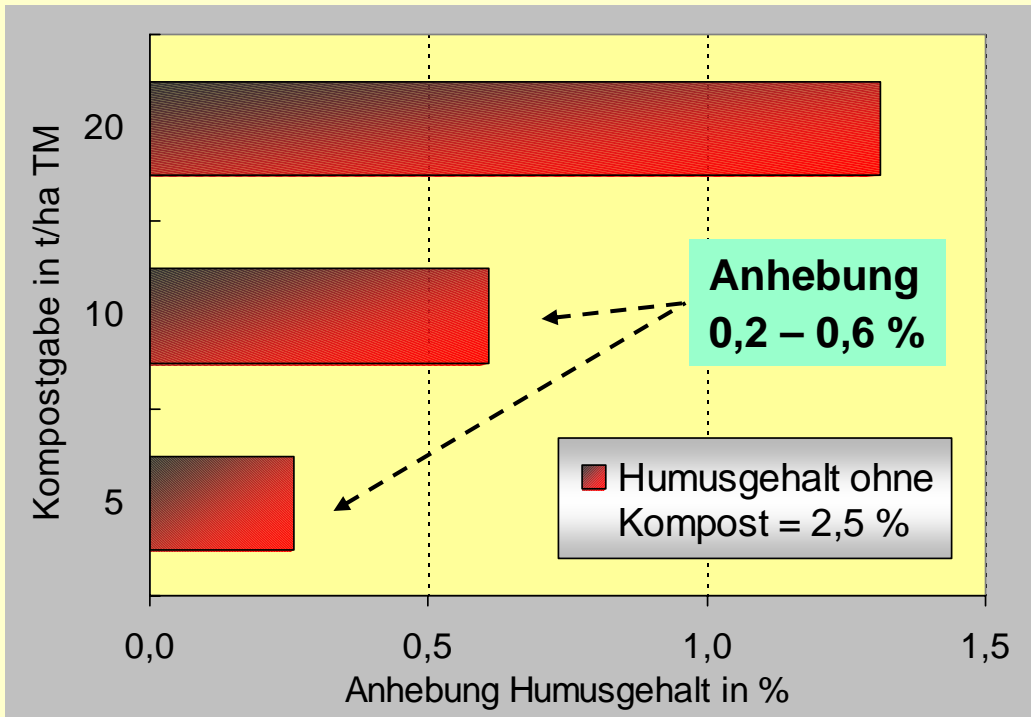
→ Compost application on average meets the humus demand due to its high content of reproducible C

Humus balance - compost

Results of field trials with **compost** in Baden-Württemberg:

Trend of the humus balance in the soil (average after 9 and 12 years)

Average input: 2 - 3 t DM/ha in 3 years



Practical use:

- **Stabilisation or slight increase of humus content**
- **High reproduction of humus**
- **Sustainable reproduction of humus by stable humus forms**

Balance sheet of lime - compost

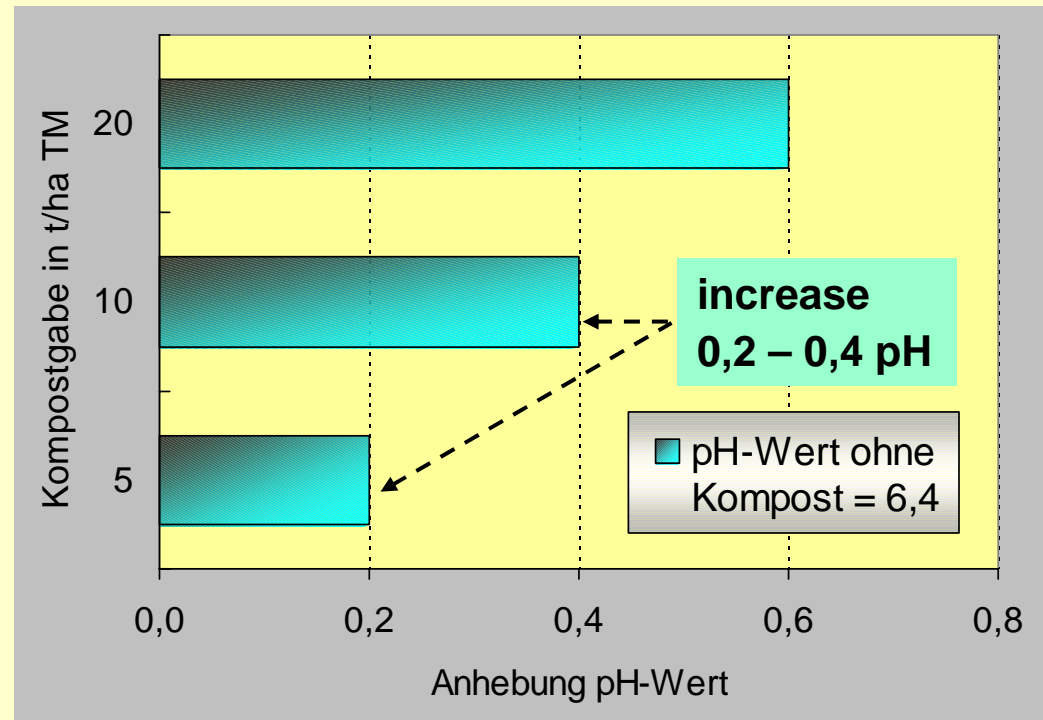
Results of field trials with **compost** in Baden-Württemberg:

Trend of the content of lime in the soil (average after 9 and 12 years)

Average input: 2 - 3 dt/ha yearly

Practical use:

- Stabilisation or increase of the pH-value
- Input of lime complies with preservation of lime



Conclusion - general parameters

compost

biogas residues

humus

High effect on humus balance

- Input equals humus demand of soils
- High humus reproduction
→ ca. 50 % of C-Input
- Main advantage
→ **Improvement of soil**

Low effect on humus balance

- Input only effective at high rates
(> 30 t/ha) (C-Decomposition!)
- Relatively low humus reproduction
→ only 20 - 30 % of C-Input

lime

Significant effect on soil-pH:

- High lime input →
4 - 5 dt/ha CaO bei 10 t/ha DM
- Equivalent to **preservation of lime**
- Soil pH stable or slightly increasing

No effect on soil pH:

- Low lime input →
1 dt/ha CaO bei 30 t/ha FM
- pH-value of biogas residues relatively high →
risk of NH₃-volatilisation

Results of analysis

- **Nutrients:**

- total content of nutrients (N, P, K, Mg)
- soluble nutrients (Nitrat, Ammonium, P, K, Mg)

- **General parameter:**

organic matter, base active matter, C/N-ratio

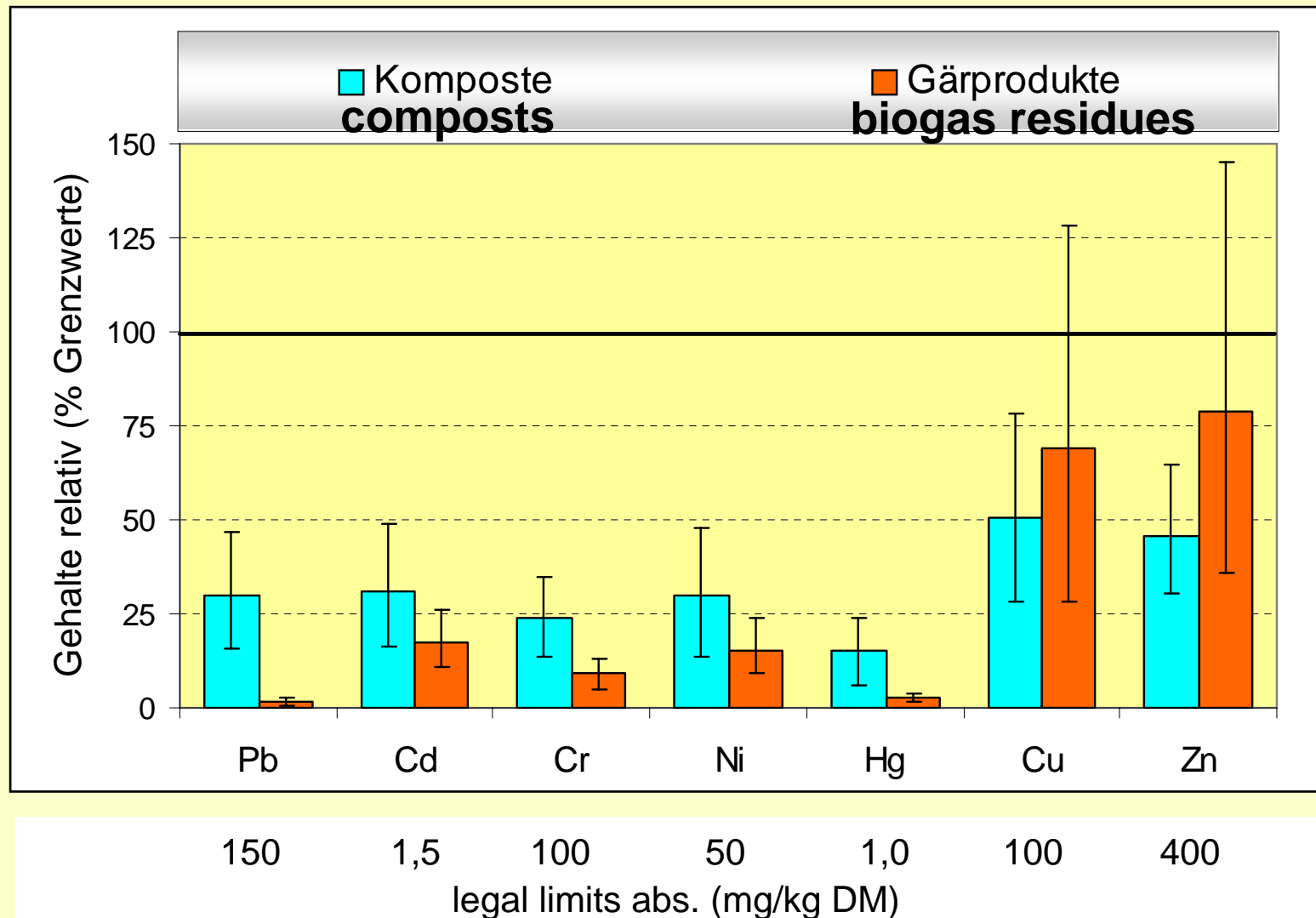
- **Undesired substances:**

total content of heavy metal (Pb, Cd, Cr, Ni, Cu, Zn, Hg)

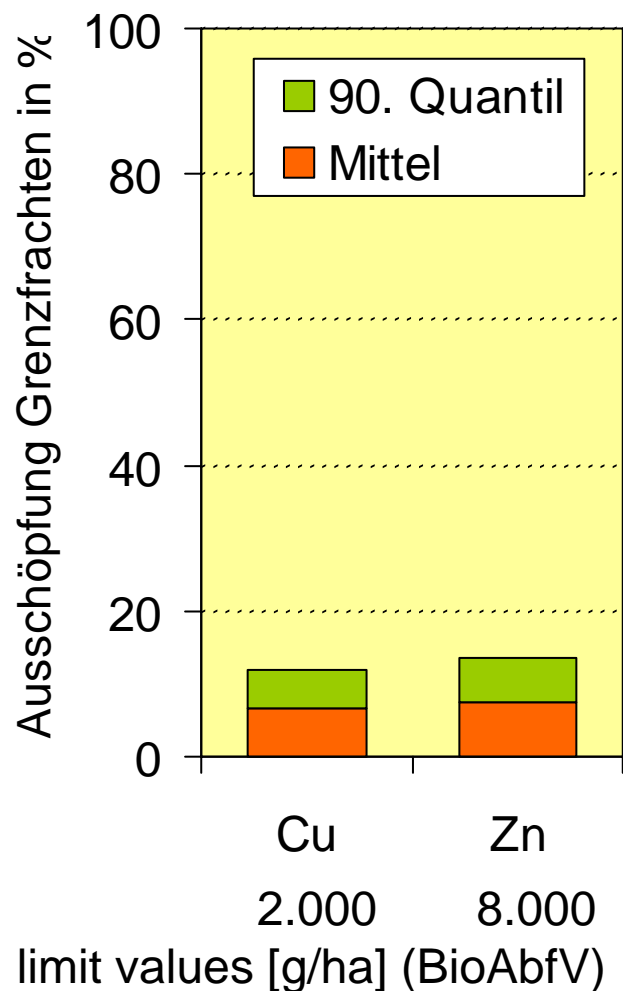
- **hygiene:**

Salmonellen, e. coli

Contents of heavy metals applied in relation to legal limits (BioAbfV) by fertilising of compost (20 + DM/ha)



Cu- and Zn-loads - Contents of heavy metals applied in relation to legal limits (BioAbfV) by fertilising of compost (20 t DM/ha)



Cu- and Zn-contents of biogas residues can markedly surpass the legal limit values (BioAbfV)!

However:

Cu- and Zn-loads (Cu: 130 g/ha; Zn: 600 g/ha) are in reality always smaller than limit values.

Consequently:

No problems for soil protection!

Cu und Zn can even be desired **micronutrients**.

Summary

- Composts and biogas residues are valuable organic-mineral fertilizer in agriculture.
- Compost as compared to biogas residues has lower nutrient effects, but regular fertilizing with composts improves the soil with regard to physical and biological properties.
- Multiple investigations and long-term field trials with both fertilizers confirm these results.
- Composts and biogas residues of good and controlled quality offer no risks for soil, (ground-) water, humans and the environment if applied correctly.

literature

Nachhaltige Kompostanwendung in der Landwirtschaft.

Abschlussbericht 2007. (Sustainable compost application in agriculture. Final report 2007) LTZ Augustenberg, Karlsruhe

https://www.landwirtschaft-bw.info/servlet/PB/menu/1230804_11/index1215167725154.html

Inhaltsstoffe von Gärprodukten und Möglichkeiten zu ihrer geordneten pflanzenbaulichen Verwertung

Projektbericht 2008 LTZ Augustenberg, Karlsruhe

https://www.landwirtschaft-bw.info/servlet/PB/menu/1230804_11/index1215167725154.html



Thank you very much
for your attention!