INBIODYN TRIAL AT HGU – A LONG-TERM EXPERIMENT COMPARING INTEGRATED, ORGANIC AND BIODYNAMIC VITICULTURE

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SHORT HISTORY OF ORGANIC AGRICULTURE

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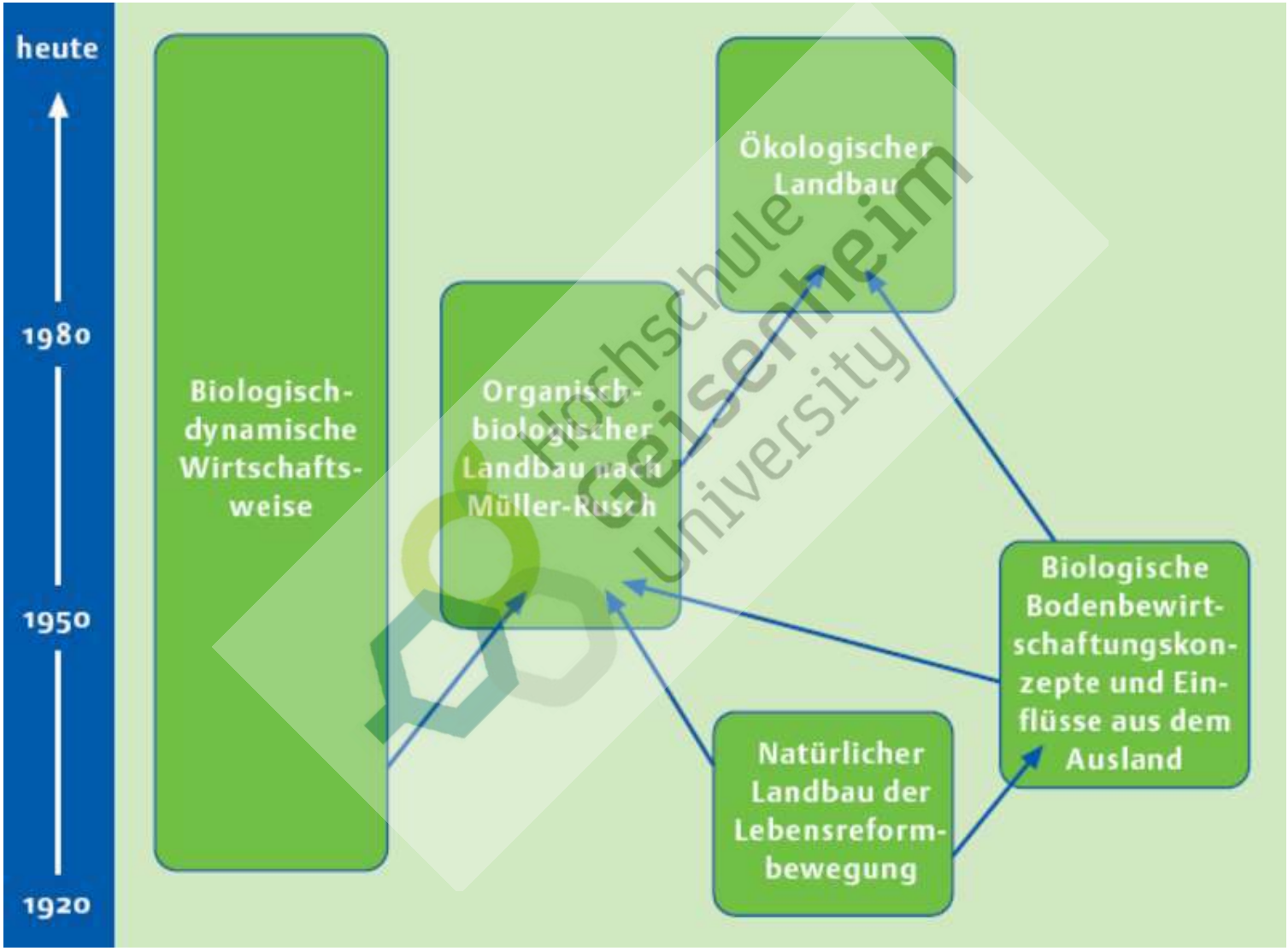
- Concept began in the early 20th century
- Mainly in Europe (Germany, Switzerland and UK), but also in the US
- Problems of agriculture at the time:
  - Soil depletion and erosion, decline of crop varieties, low food quality, rural poverty, **new diseases** (concerning plants and animals)
- „new“ form of agriculture is developed: mineral fertilizers and synthetic pesticides are introduced at that time
- Holistic approach of pioneers of organic agriculture: long-term vitality of soil („feed the soil“)
- <u>Practice:</u> managing crop residues, applying animal manures, composting, green manuring, rotation of crops, adding lime and other rock dusts
- Experiments on self-subsistence (life-reform movement)

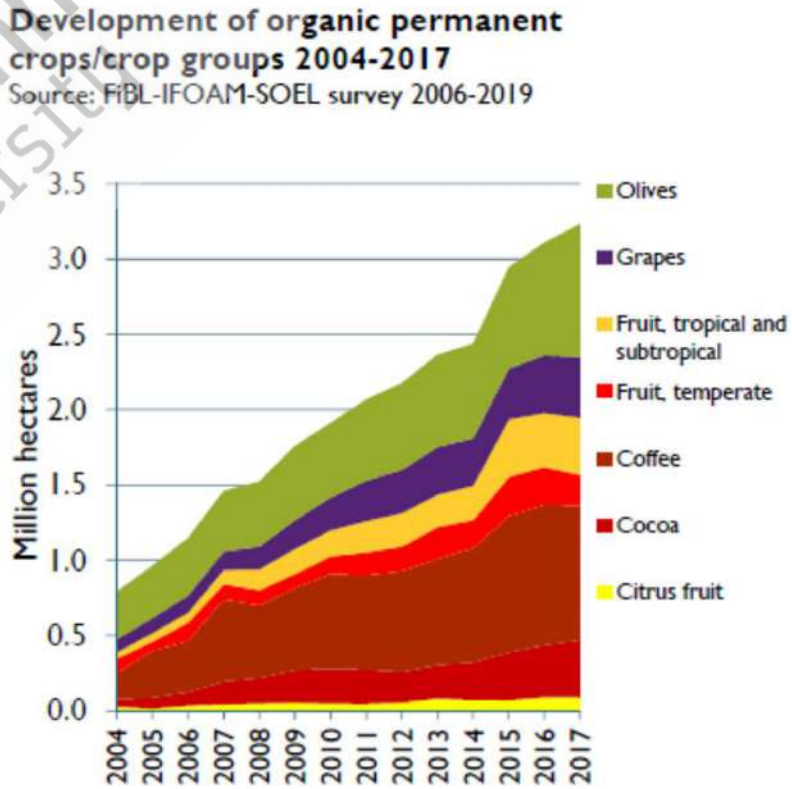
SHORT HISTORY OF ORGANIC AGRICULTURE



- http://www.boelw.de/

INTRODUCTION

- Demand and production of organic crops have been rapidly growing in the last few decades around the world → based on consumer demands for organic food and environmentally friendly production
- Organic grape area worldwide 5,7 % (Willer and Lernoud 2019)
- Organically managed viticultural surface worldwide increased from 88.000 ha in 2004 to ~ 400.000 ha in 2017 (Willer et al. 2019), mostly located in Europe (90%)
- In Spain 81000 ha (8,4%), in France 64800 ha (8,5%), in Germany 7300 ha (7,3%) of organic and biodynamic viticulture (Willer et al. 2019)
- Some of the most prestigious domains convert to organic or biodynamic viticulture



INTRODUCTION

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Aim of the study:

- comparing existing management systems
- searching for reasons of changes
- management steps responsible → provide guidance for defining more effective farming systems

- Optimizing the respective management systems
- Unravelling long-term effects of integrated, organic and biodynamic viticulture

MANAGEMENT OF FIELD TRIAL

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- <u>management systems:</u>
  - integrated (code of good practice)
  - organic (EU VO 834/07 and ECOVIN Guidelines)
  - biodynamic (EU VO 834/07 and DEMETER Standards)

ECOVIN

demeter

	integrated	organic	biodynamic
cover crop	grass mixture (alternating)	Wolff-mixture (alternating)	
under-vine-management	herbicides	mechanically	
fertilization	green waste compost + mineral fertilizers	compost + ploughing up the cover crop	compost with biodynamic preparations (or cow pat pit preparation) + ploughing up the cover crop
plant protection	systemic fungicides	copper (3 kg/ha *a max.) sulfur plant strengtheners	
biodynamic preparations	-	-	horn manure and horn silica compost preparations

MANAGEMENT OF FIELD TRIAL

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organic

integrated

biodynamic

BIODYNAMIC VITICULTURE

- Application of biodynamic preparations, teas, plant extracts etc.
- Biodynamic preparations:
  - Field spray preparations: horn manure and horn silica




  - Compost preparations: yarrow, camomile, stinging nettle, oak bark, dandelion, valerian


BIODYNAMIC VITICULTURE

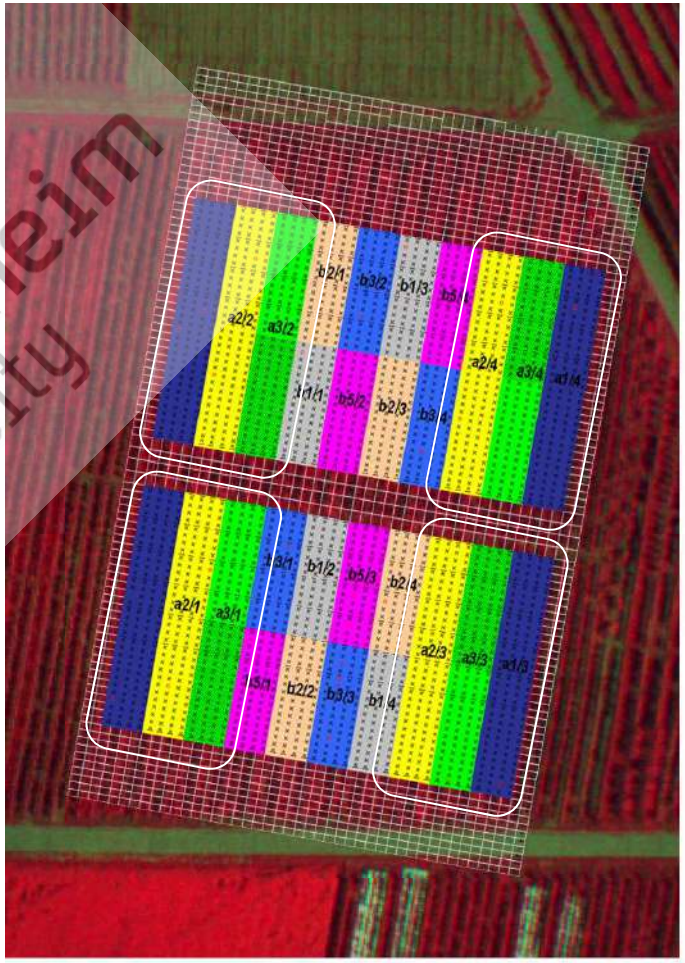
- Application of biodynamic preparations
- Field spray preparations: 1 h of stirring in warm water
- Horn manure: 2-3 times per year on soil (spring, autumn)
- Horn silica: 3-4 times during growing season on plants

- Compost preparations: in compost

source: www.entrup119.de

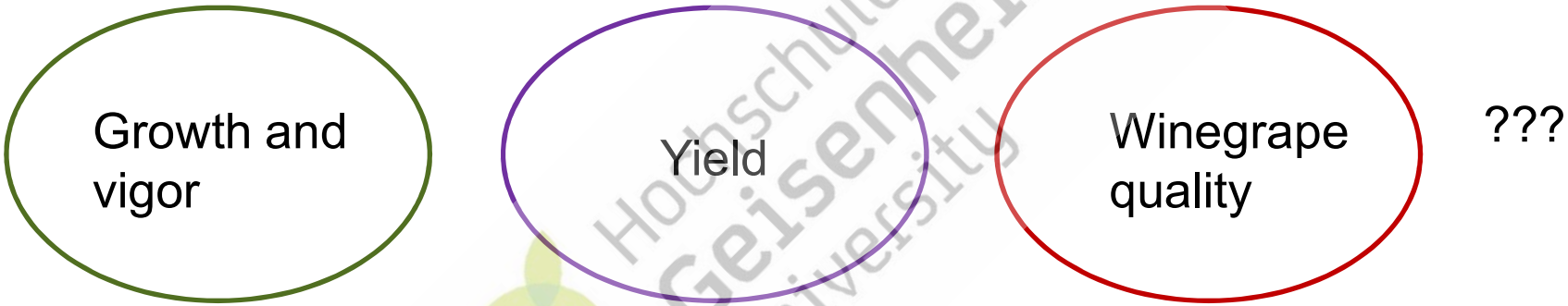
DESIGN OF FIELD TRIAL

- Geisenheim, Germany
- long term annual rainfall: 540 mm/m²
- soil: sandy /clay loam
- experimental site 0.8 ha in size
- planted in 1991
- start of conversion 2006
- VSP system
- row spacing: 2 m
- inter-vine-spacing: 1.2 m
- *Vitis vinifera* L. cv. Riesling Gm 198-30
- rootstocks: Börner, SO4
- complete block design (4 replicates)
- each block: 4 rows with 32 vines
- balanced fixed factorial ANOVA (factors treatment, rootstock, block, year) + Post-Hoc-Test (Tukey-Test; p=0.05)



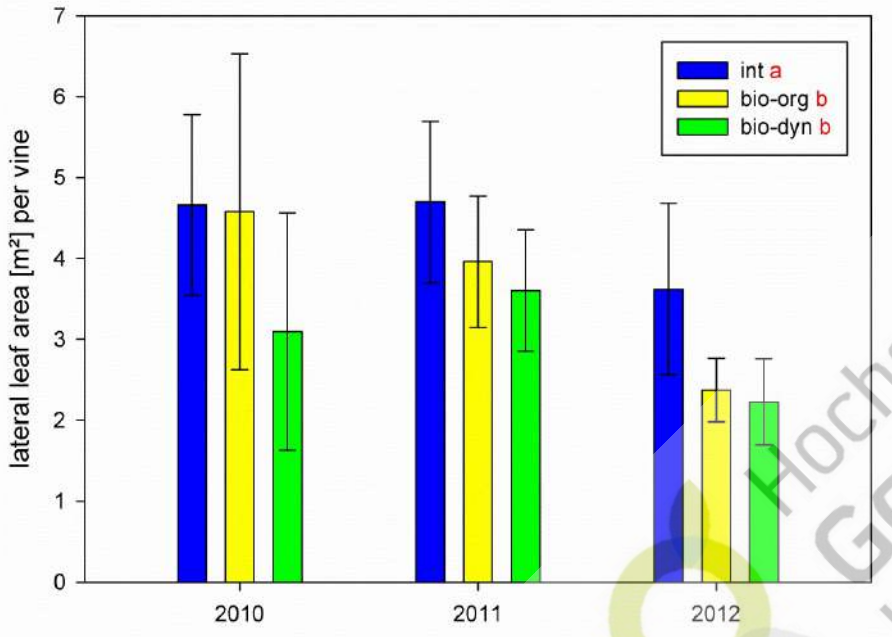
RESULTS

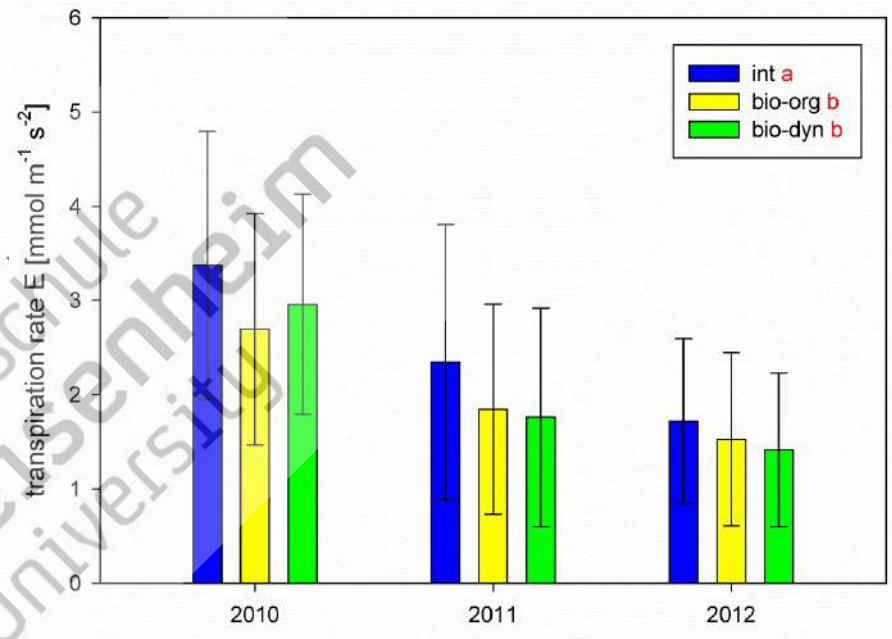
- Do the management systems differ in



- If they differ:
  - What might be the **reasons**?
  - Which **management steps** might be **responsible** for the changes?

RESULTS – GROWTH AND VIGOR



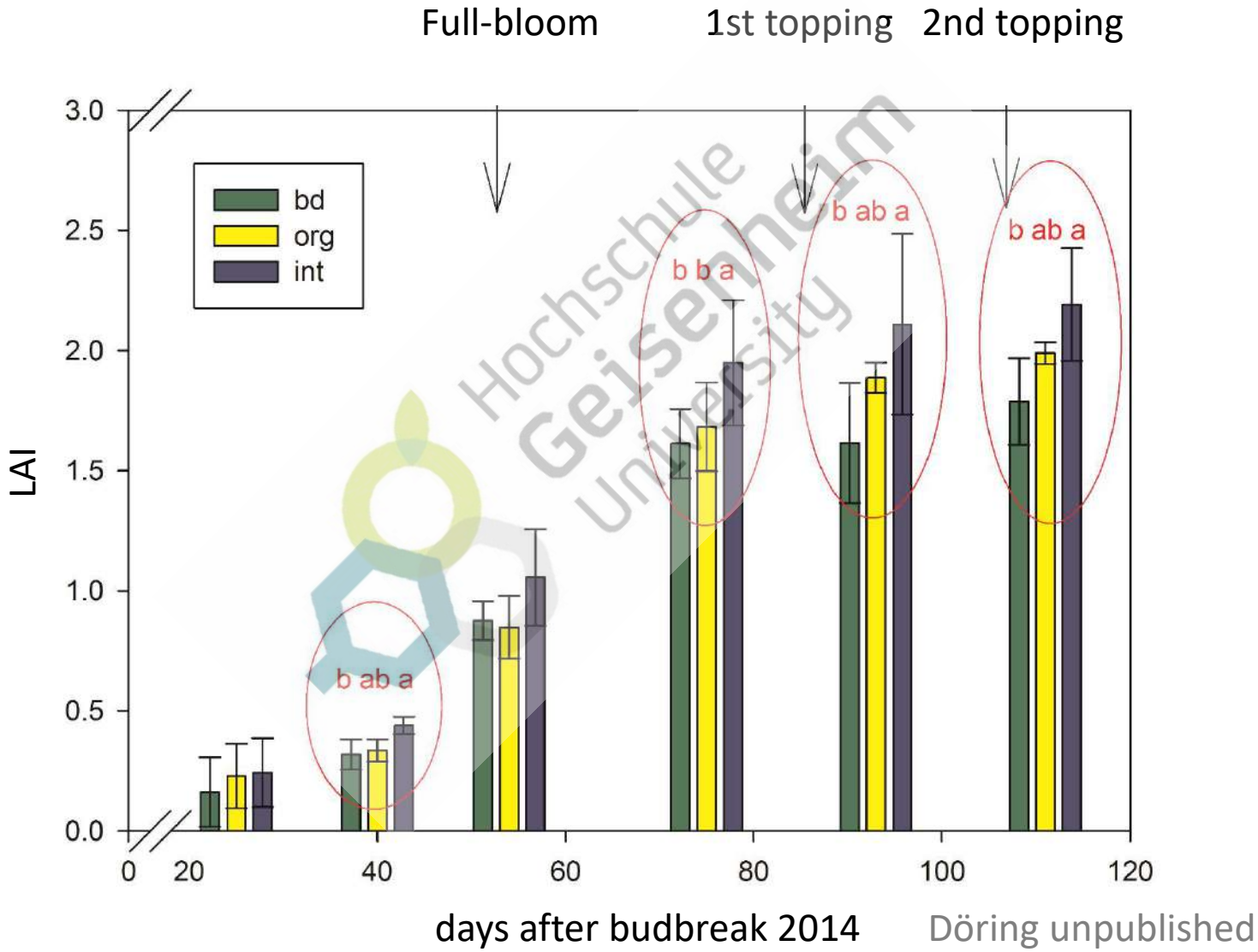


▼organic and biodynamic treatments show significantly reduced growth (pruning weight, internode length + shoot length primary shoots, lateral leaf area)

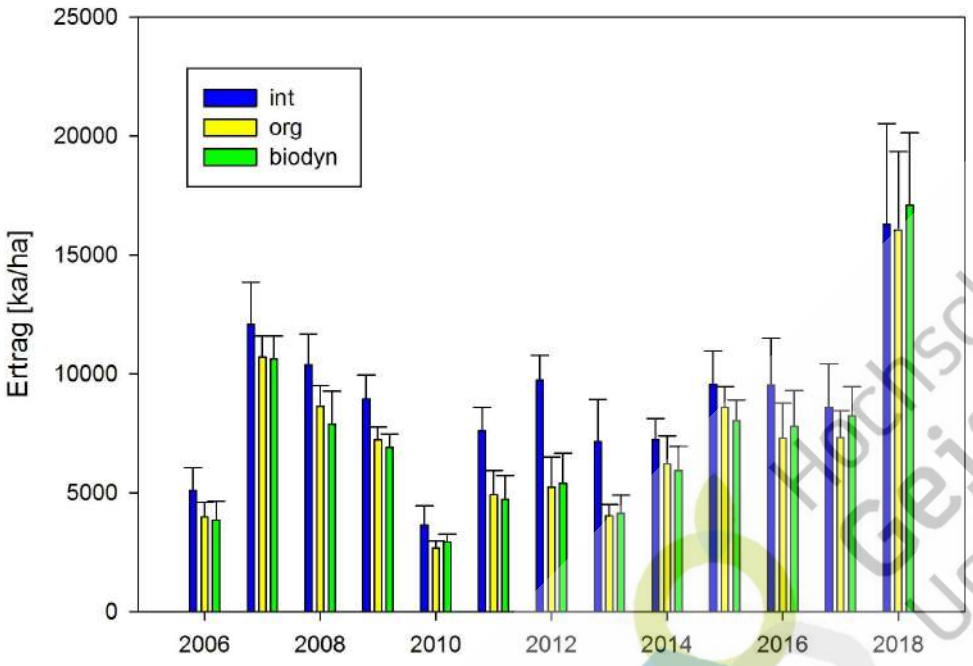
(Meißner 2015; Döring et al. 2015)

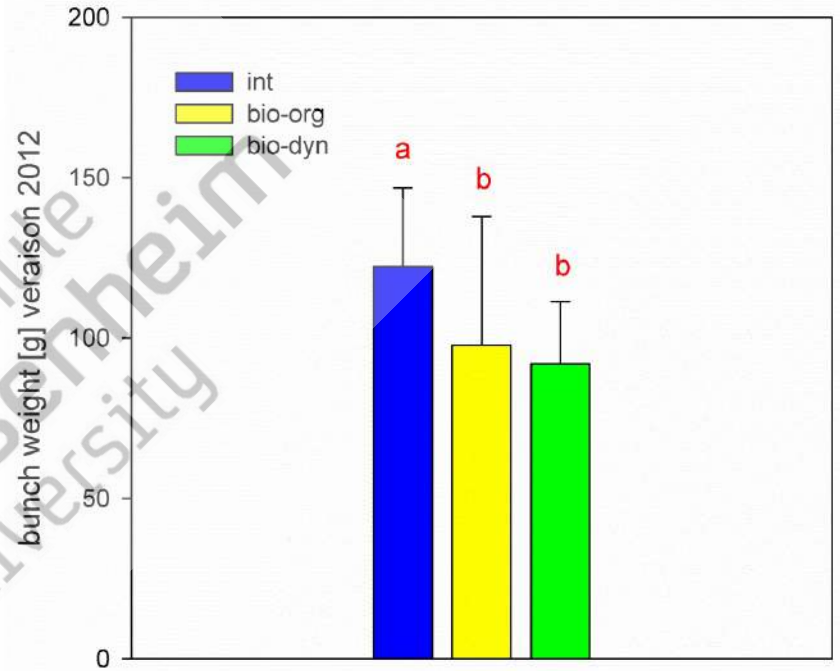
- **reasons**: nitrogen supply? physiological activity? water relations?
- **management steps responsible**: soil management and fertilization strategy

RESULTS – GROWTH AND VIGOR



RESULTS - YIELD





▼organic and biodynamic treatments show significantly reduced yields

(Meißner 2015; Döring et al. 2013; Döring et al. 2015)

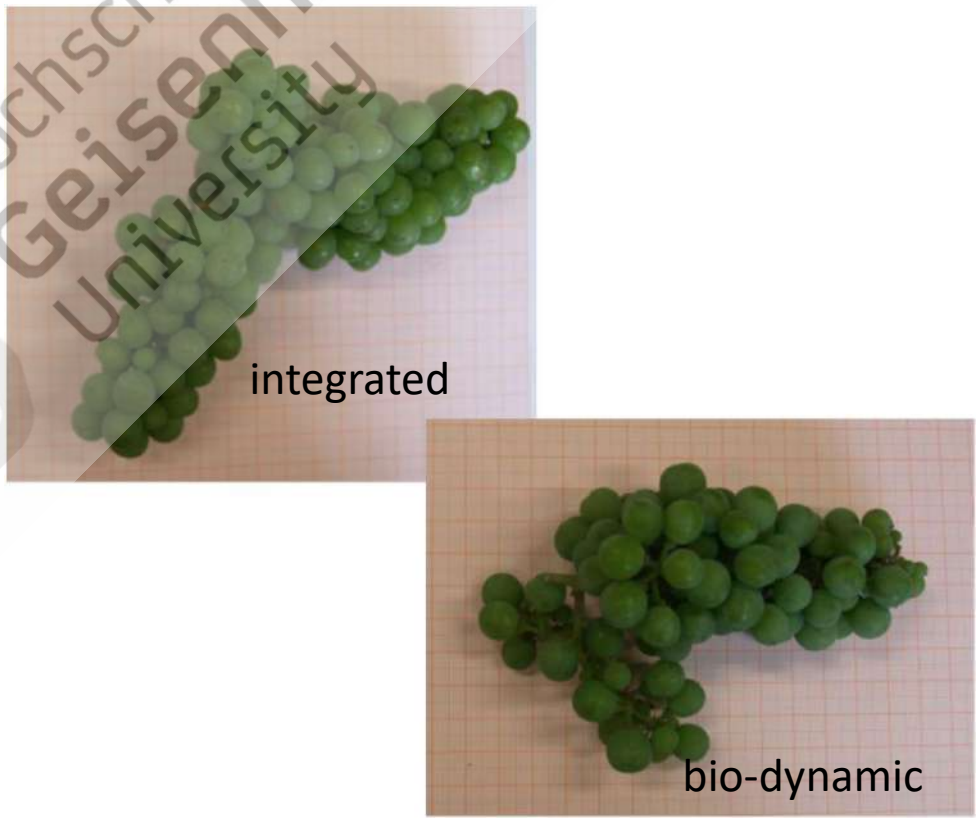
- **reasons**: infection with *Plasmopara viticola*? bunch architecture?
- **management steps responsible**: plant protection strategy, soil management

RESULTS - YIELD

Changes in bunch structure in organic and biodynamic viticulture?

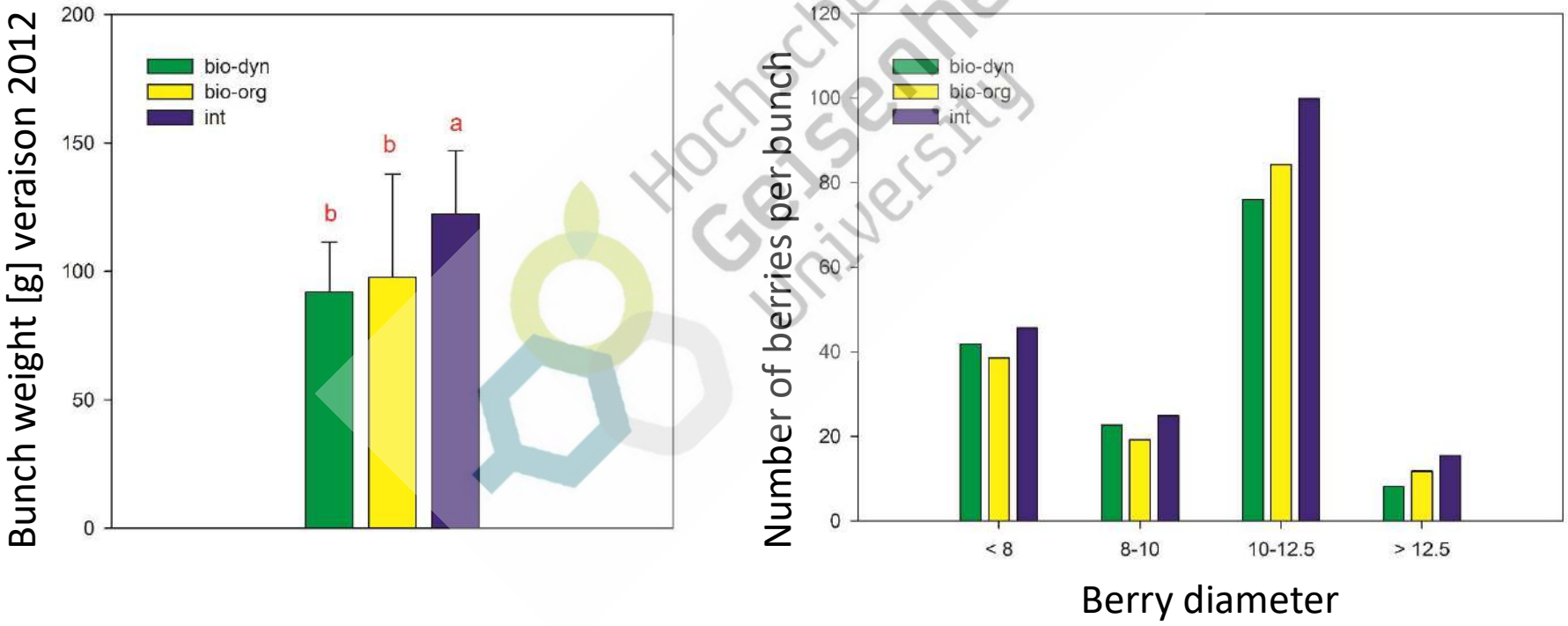
- Lower bunch weight
- Lower compactness
- Less berries
- Smaller berries

(Döring et al. 2013)



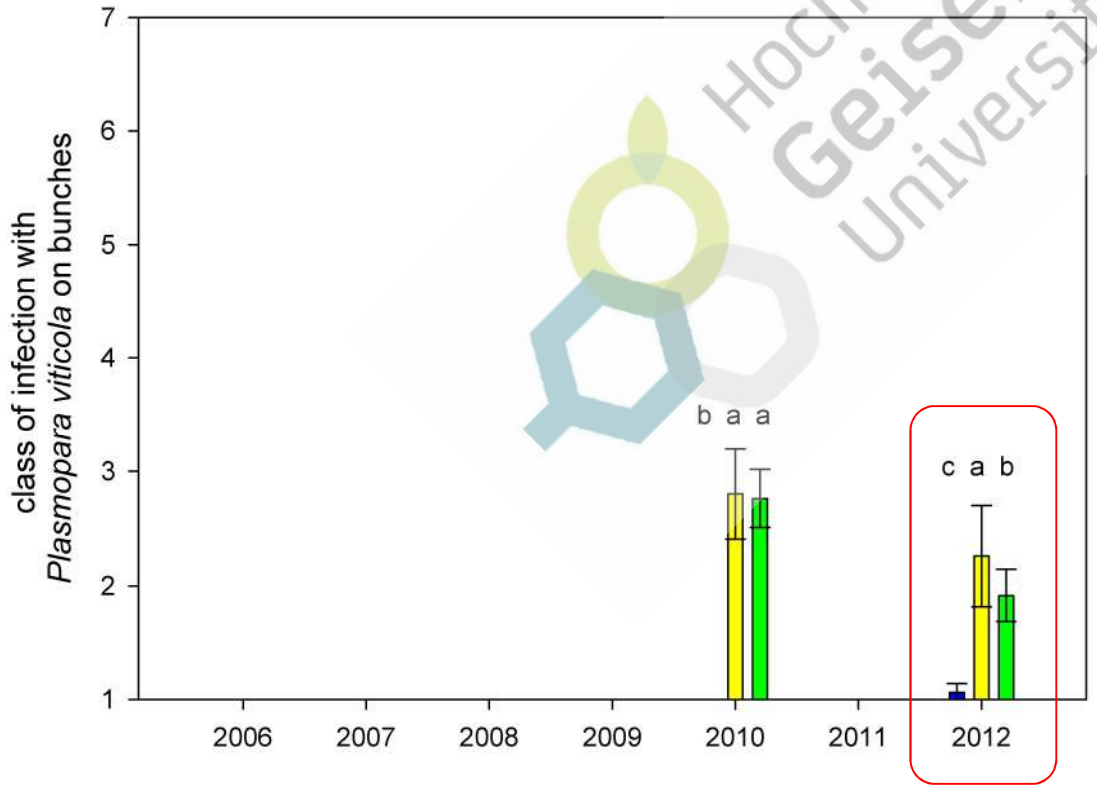
RESULTS - YIELD

- Significantly different **bunch structure** (Döring et al. 2013)

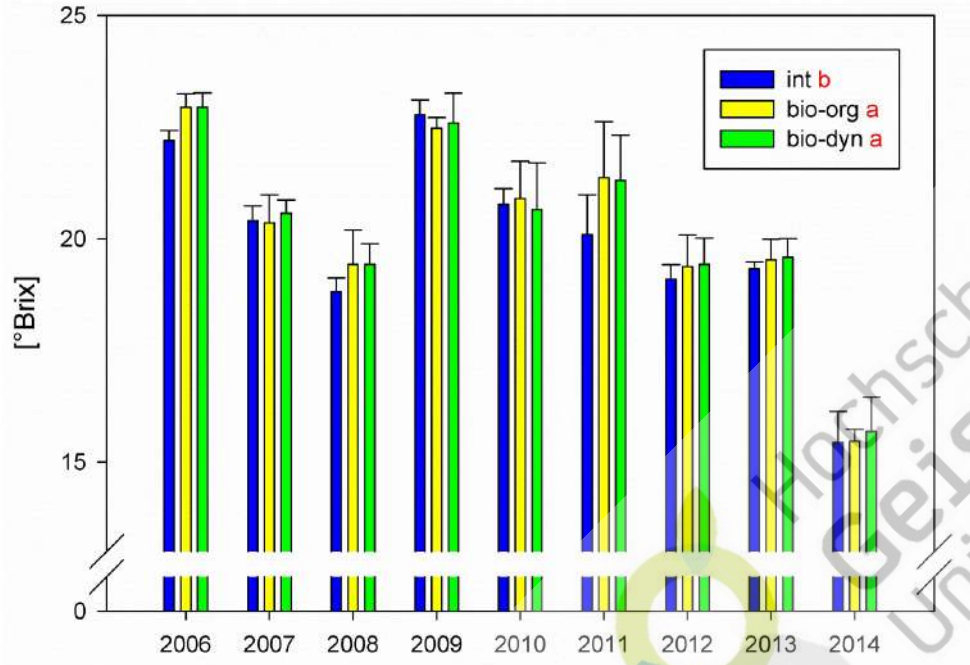


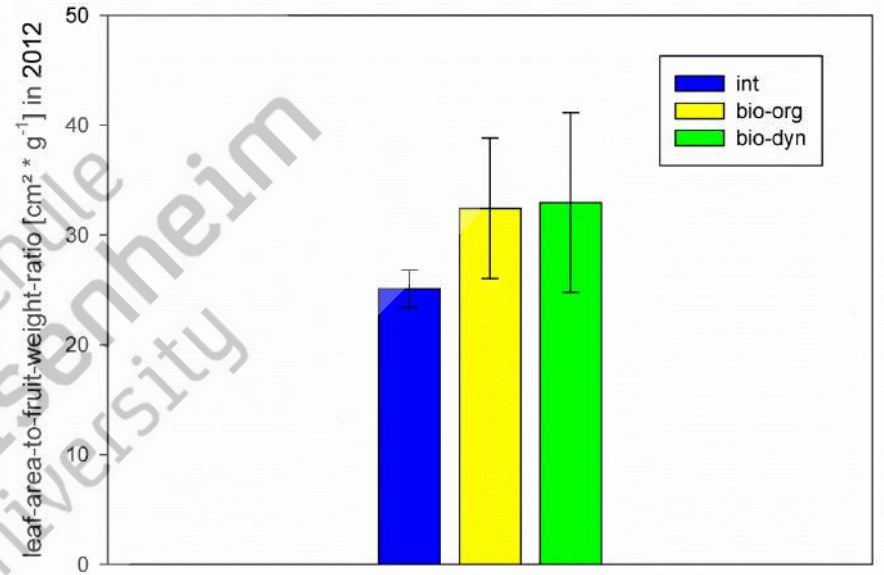
RESULTS - YIELD

- Organic and biodynamic viticulture:
  - **5-10%** of yield loss due to downy mildew in some years (Meißner 2015; Döring et al. 2015)



RESULTS – WINEGRAPE QUALITY





▲organic and biodynamic treatments show significantly higher total soluble solids at harvest

►no difference in total acidity or pH (Meißner 2015; Döring et al. 2015)

- **reasons**: leaf-area-to-fruit-weight-ratio?
- **management steps responsible**: plant protection strategy, soil management and fertilization strategy

RESULTS - SOIL

- **Fungal species richness** does not differ among management systems
- But substantial differences in relative species richness and community composition (Hendgen et al. 2018)
- Results are supported by Morrison-Whittle et al. (2017)

- **Bacterial species richness** significantly higher under organic/ biodynamic viticulture in Geisenheim field trial 12 years after conversion
- Species community differs among integrated vs. organic/ biodynamic viticulture (Hendgen et al. 2018)

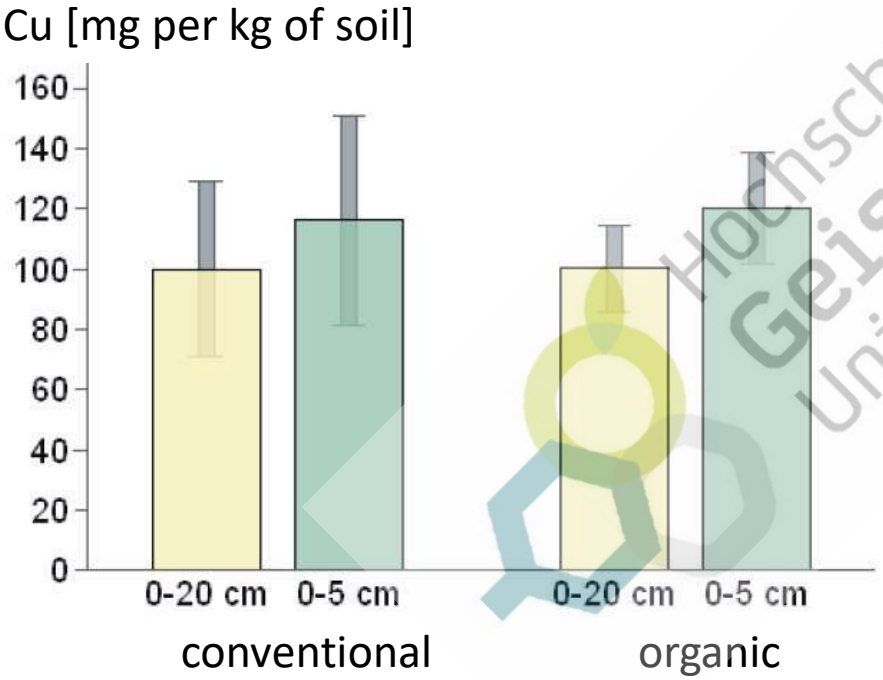
RESULTS - SOIL

- Copper products are among the oldest plant protection agents
- They still represent an important part of the plant protection strategy against downy mildew (*Plasmopara viticola*) in organic viticulture
- Cu is accumulated in the soil and high Cu content in vineyard soils is mainly due to anthropogenic input
- Cu has impact on total carbon, enzyme activities and earthworm abundance in the soil (Paoletti et al. 1998, Mackie et al. 2013)

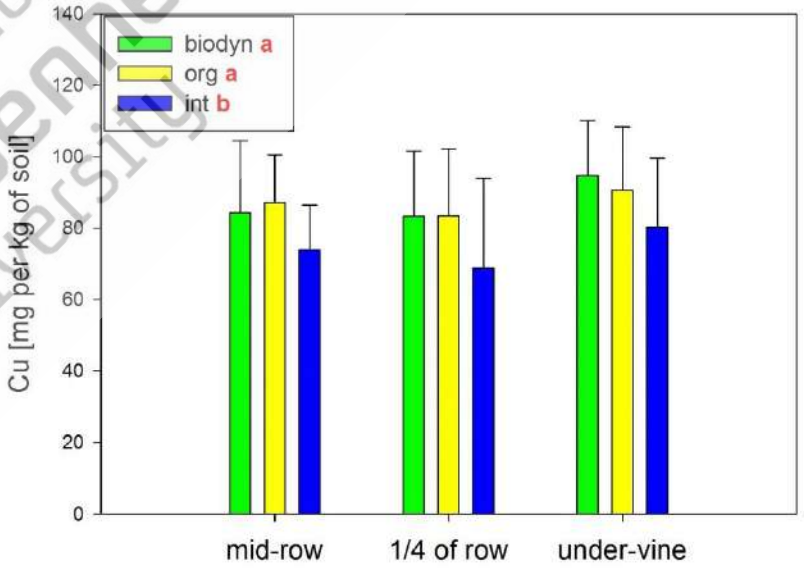
RESULTS - SOIL

- Organically managed vineyard soils in France, Croatia and Germany did not have higher Cu content compared to their conventional counterparts (Probst et al. 2008, Coll et al. 2011, Strumpf et al. 2011, Radić et al. 2014)
- Beni and Rossi (2009) observed higher total Cu contents under organic viticulture after nine years of conversion in Italy
- higher Cu levels in organic and biodynamic in comparison to integrated management after 12 years of conversion in the Geisenheim trial
- Dependent on background levels of Cu in the soil

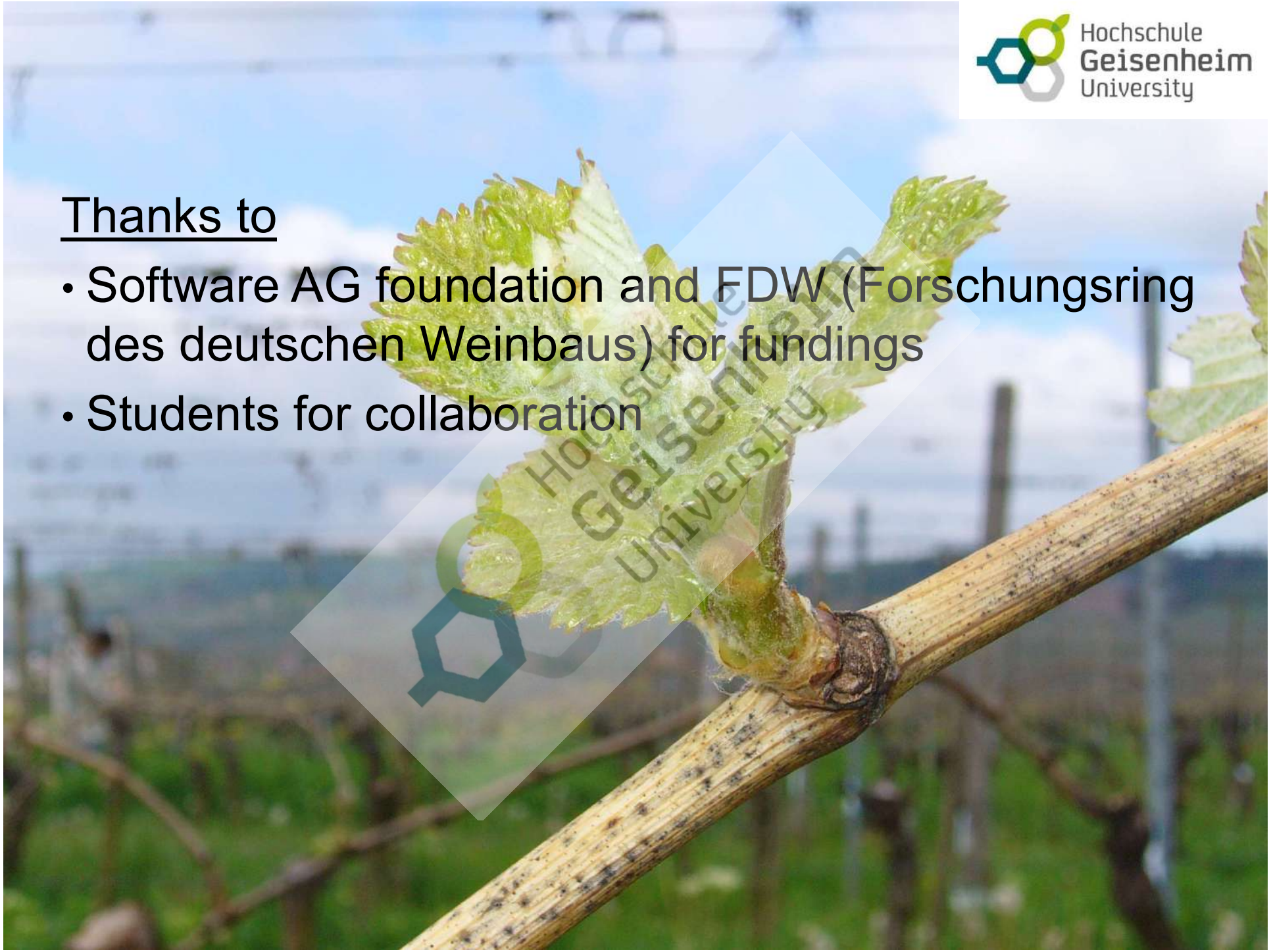
RESULTS - SOIL



Strumpf et al. (2011)



Döring et al. (unpublished)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