FACULTY OF BIOSCIENCE ENGINEERING

DEPARTMENT OF APPLIED BIOSCIENCES
LABORATORY OF CEREAL TECHNOLOGY

PLANT DEVELOPMENT, YIELDING PROPERTIES AND KERNEL COMPOSITION OF WINTER WHEAT IN RELATION TO SOIL TYPE UNDER ORGANICALLY ELEVATED TEMPERATURES

A practical proof of concept

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RESEARCH OUTLINE

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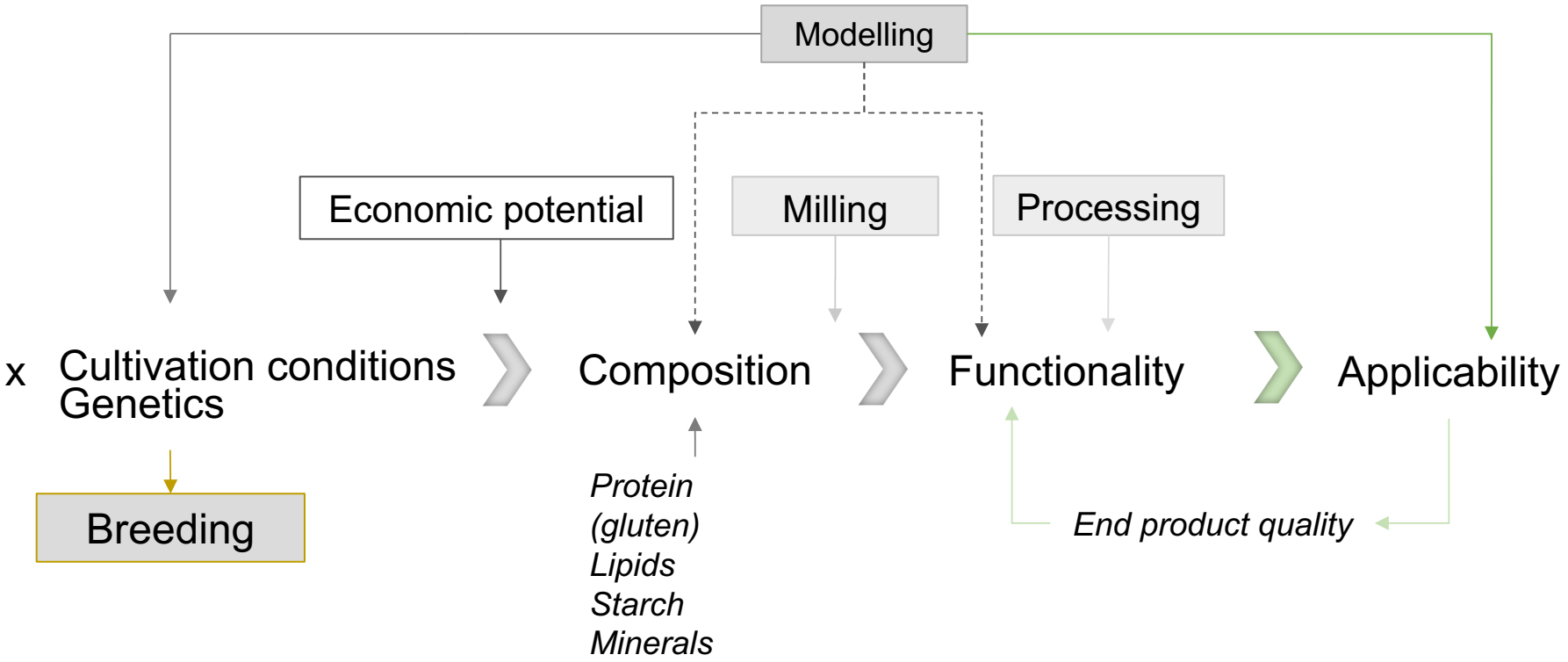
RESEARCH OUTLINE

PhD. research topic



Current interest from the food industry and gaps in literature

- How do cultivation conditions relate to the chemical composition and functionality?
- What is the contribution of the starch fraction to the end product quality?
- What is/are the optimal field(s) of application for different wheat varieties?

RESEARCH OUTLINE

Why did we focus on soil x genotype effects?

1. **Gap in literature** on the effects of various soil types with a current main focus on **plant development properties**.
    - Quality traits, beside yield, are often not looked in to but are expected to be largely influenced by the environment (heritability).
2. **Reduce** environment to sole factors to gain a more detailed, semi-fundamental, insight in the mutual relations.
    - Aids in predicting quality in a location independent way
    - Increased wheat *consumption* requires optimized distribution throughout the world: soil type and properties are more fixed.
3. **Proof of concept** was necessary to evaluate the feasibility and which hurdles were required to be overcome for this type of experiment.

MATERIALS AND METHODS

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EXPERIMENTAL SETUP

	Extremum
Sowing date	December 12th 2016
Harvest date	June 30th 2017
Growth period	200 days
Sowing density	± 350 kernels/m² *drop out*
Soil types	Coarse sand
	Polder *(heavy clay)*
Wheat cultivars	KWS Ozon, Gedser, WaxyDie
Cultivation	P/K, 3 N, 1 S
	Irrigated

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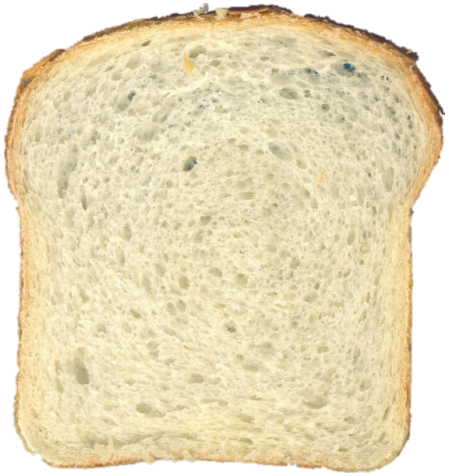
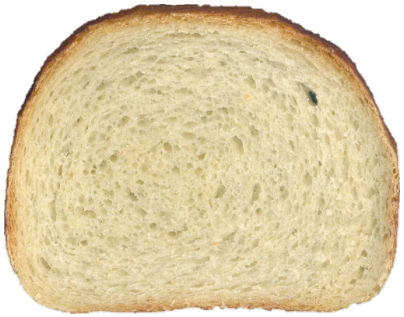
EXPERIMENTAL SETUP

Choice of wheat cultivars

	Gedser	KWS Ozon
Wet gluten content (%)	24,3	20,8
Gluten index (%)	84,5	100
G* at 20 Hz (mPa)	1621	4134
δ at 20 Hz (°)	31,3	26,9
Bread volume (*ml/kg flour*)	5374	3444





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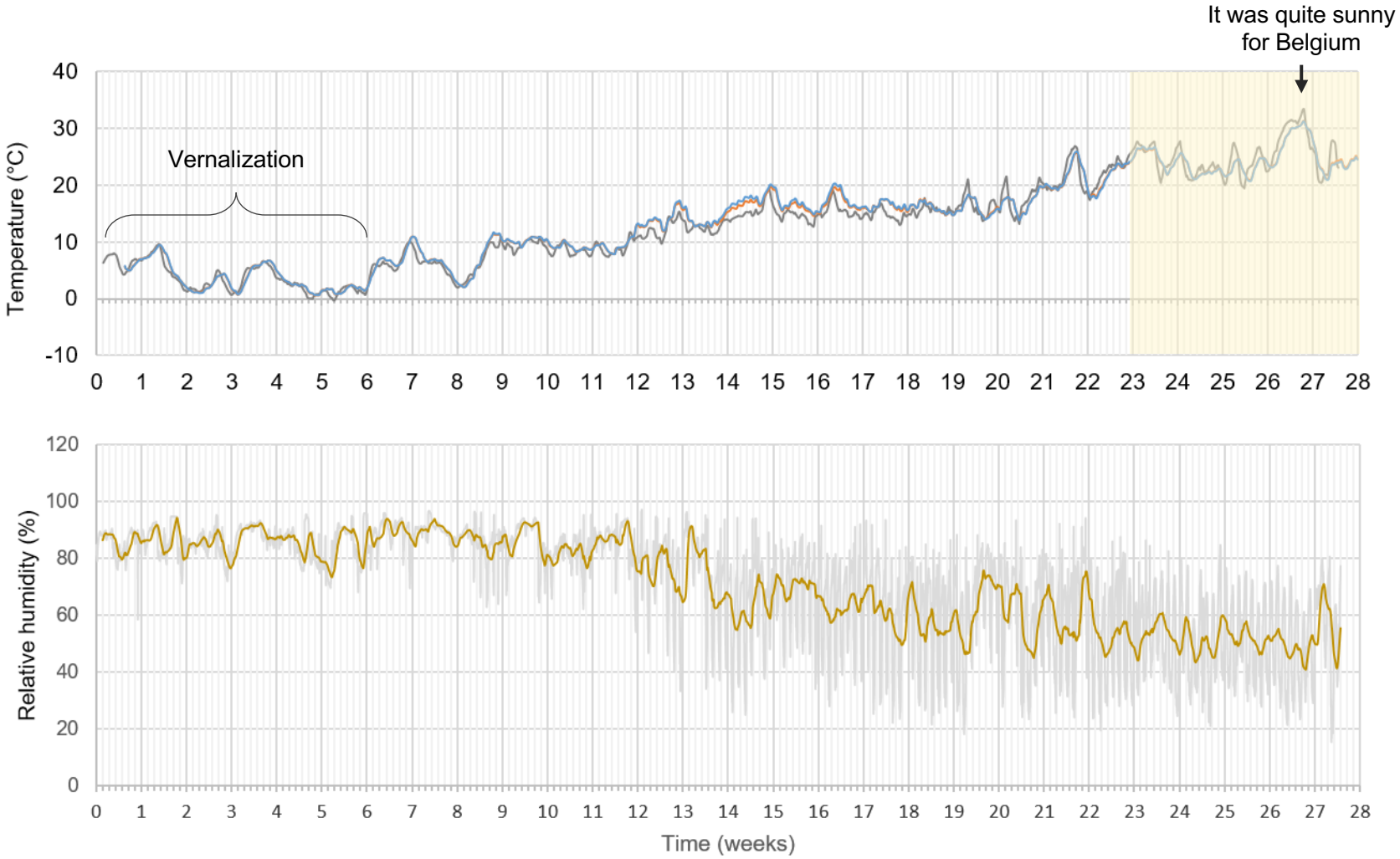
EXPERIMENTAL SETUP

Monitored environmental parameters



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RESULTS

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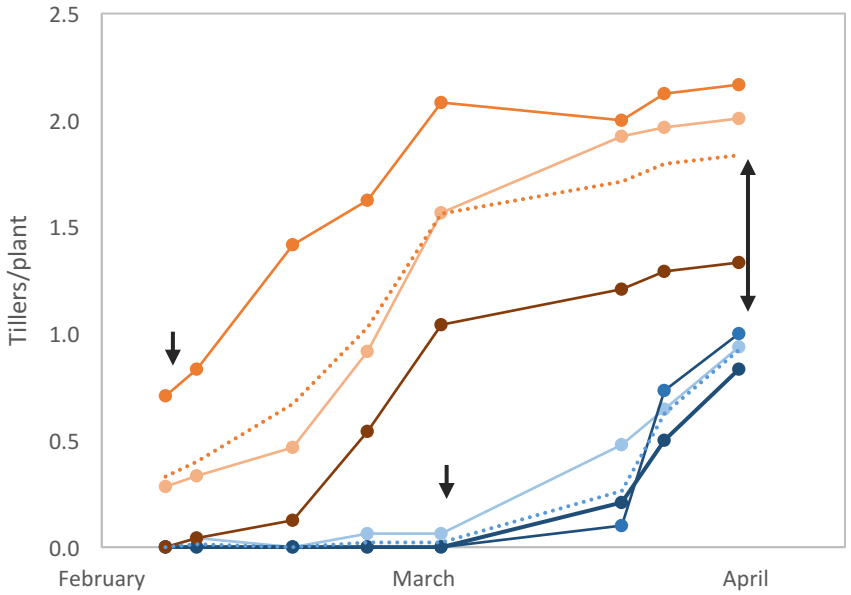
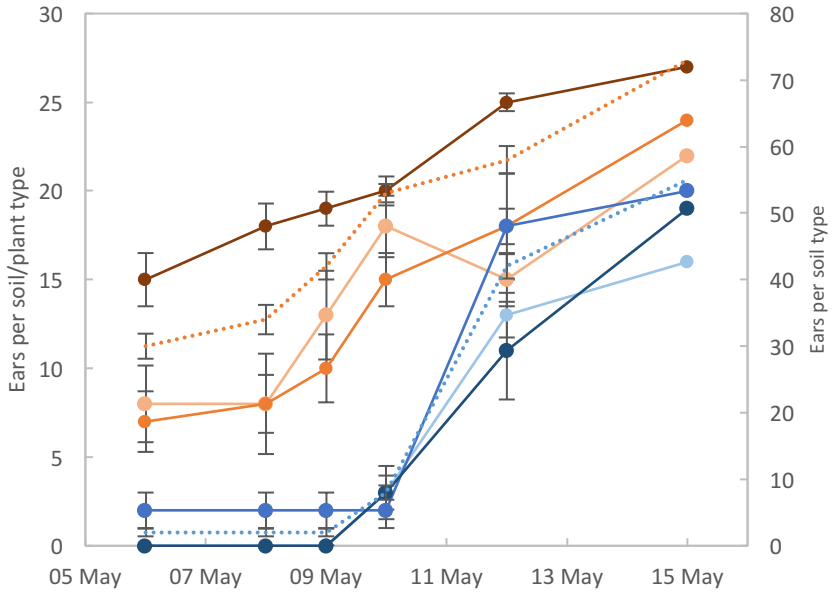
RESULTS (A)

Plant development in function of soil type





Sand Clay

Gedser

KWS Ozon

WaxyDie

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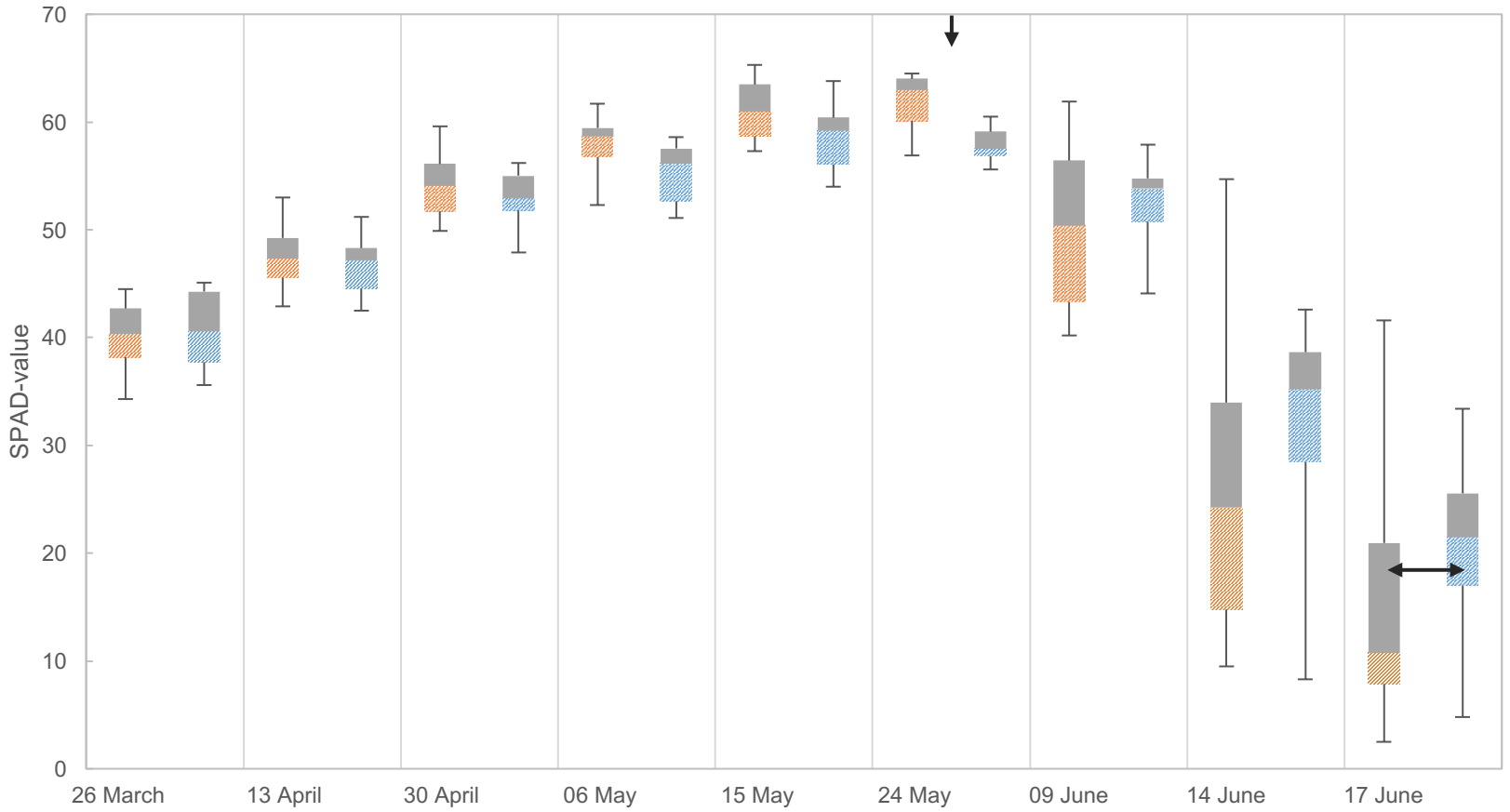
RESULTS (A)

Overall plant health in function of soil type and time



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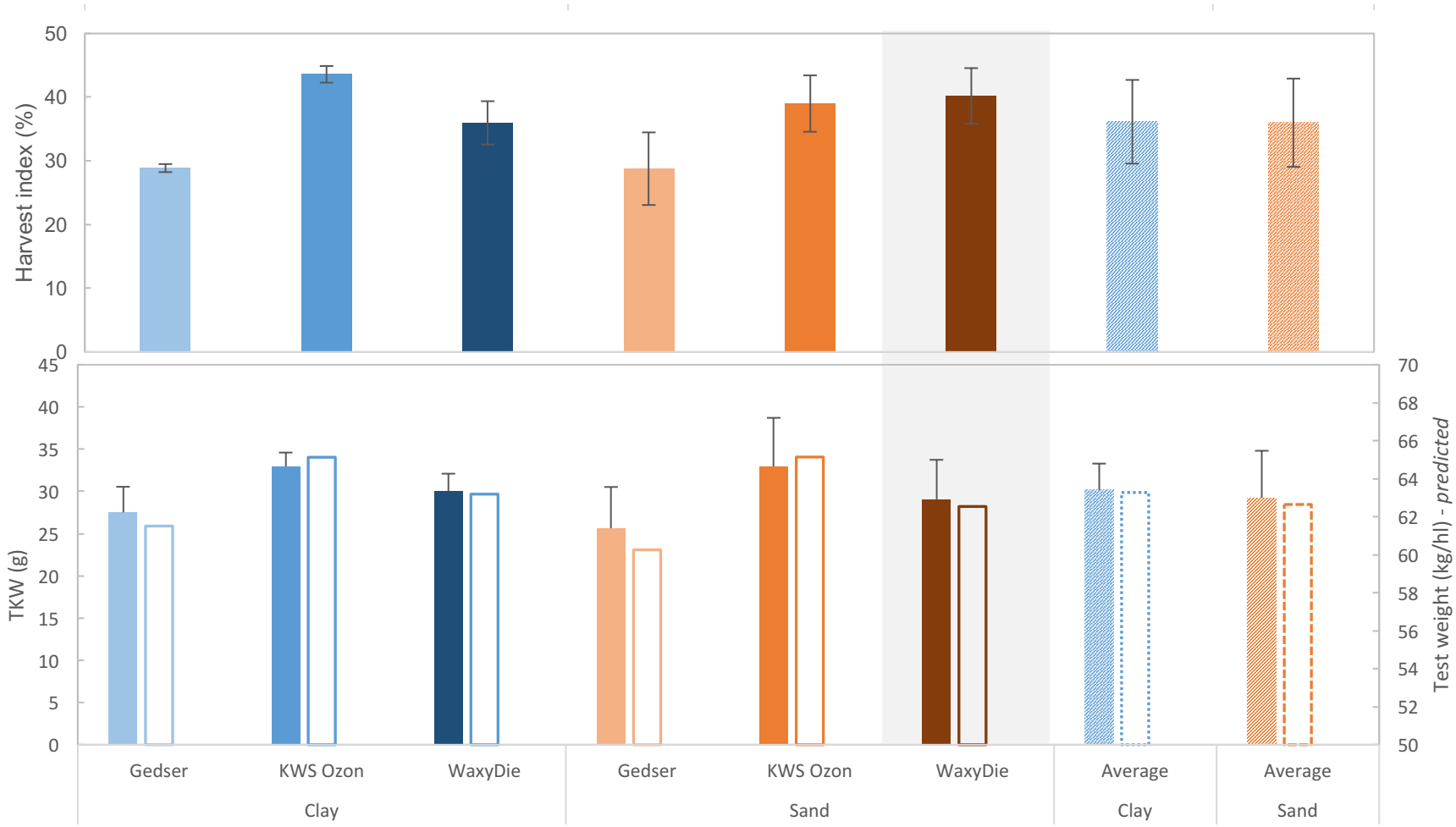
RESULTS (B)

Yielding properties



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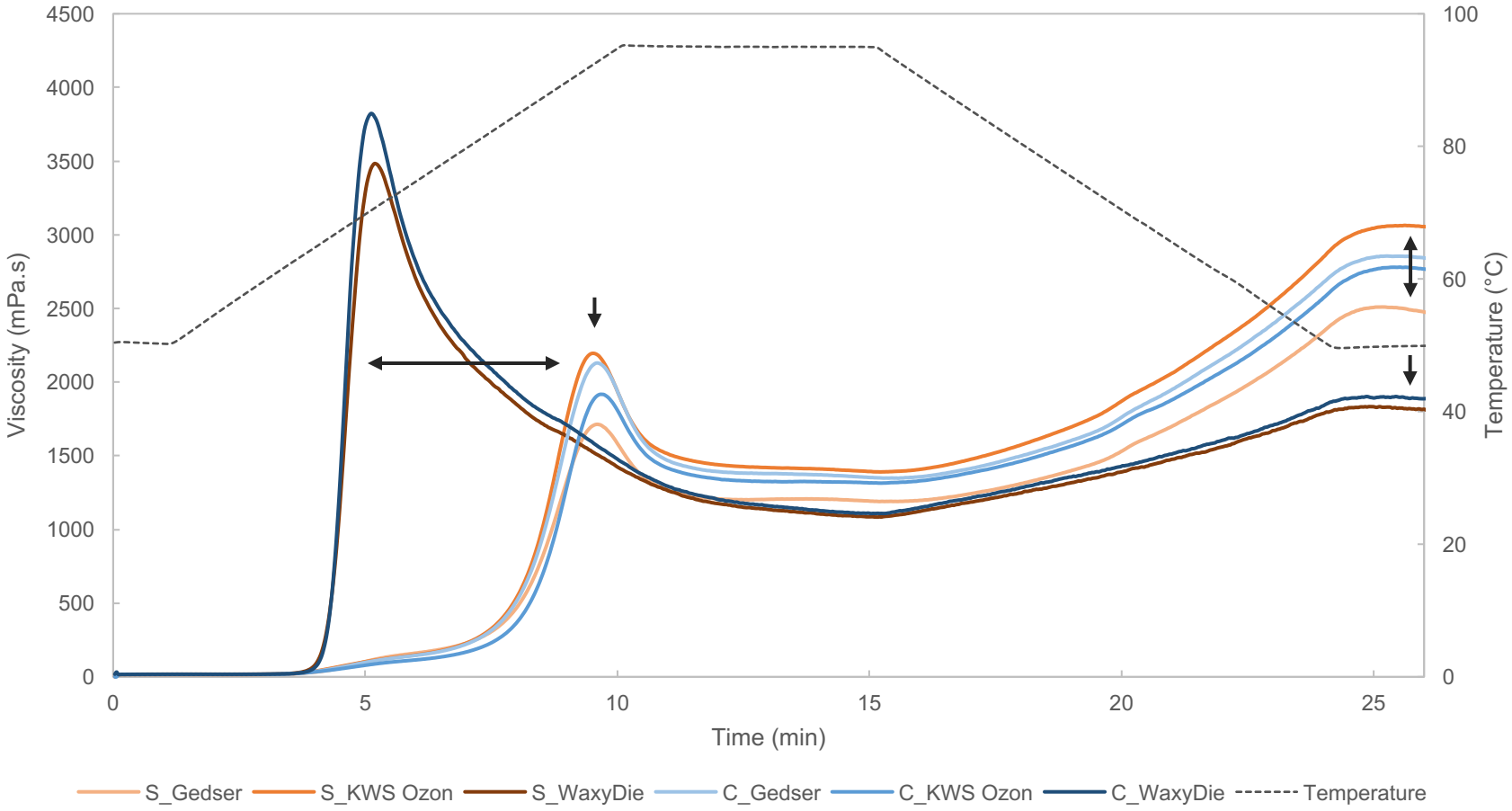
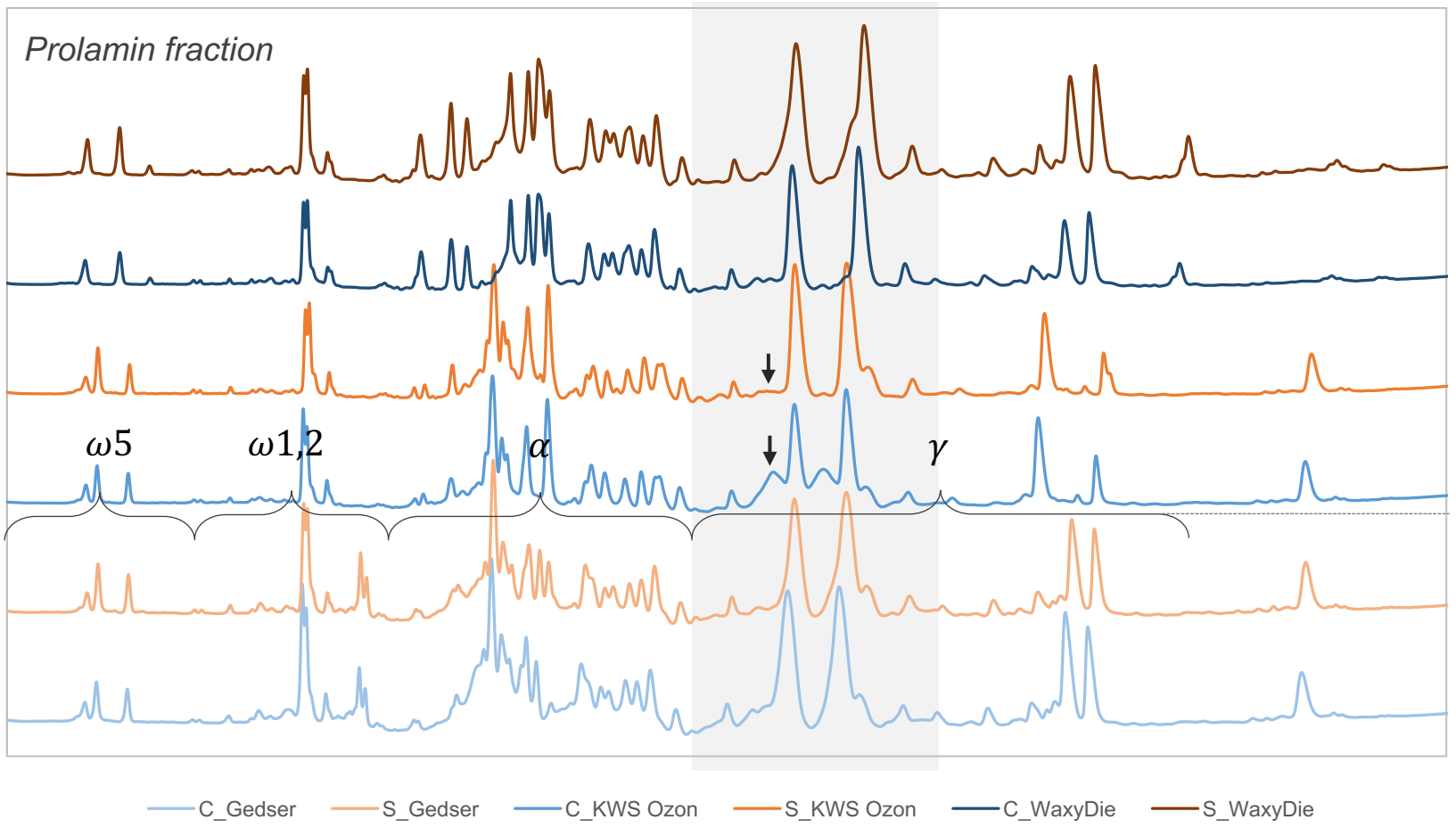
RESULTS (C)

Starch functionality in relation to soil type



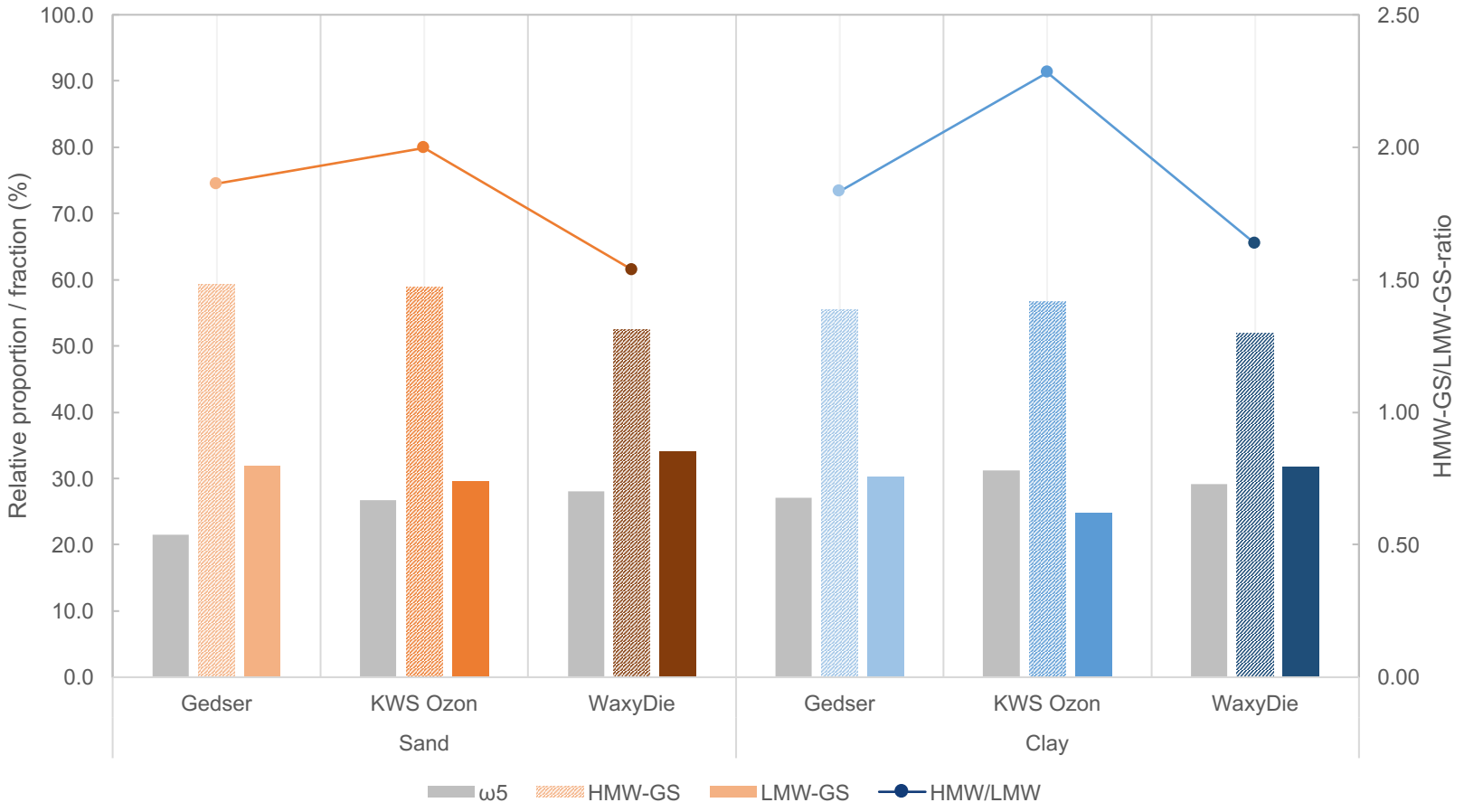
RESULTS (C)

Protein quantity and composition - prolamin



RESULTS (C)

Protein quantity and composition - glutelin



RECAP

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RECAP

Major key concepts and take home messages

1. Experimental setup **appears to be easy** and straightforward but only when the research question is narrowed down.
    - **Drought stress** should be studied in a separate, analogous trial, keeping in mind the timing, intensity and duration of the drought.

RECAP

Experimental design considerations

Soil	Environment	Growth parameters	Plant material	Kernel
Type	Relative humidity	Plant height	(dry) weight	Concentration and composition (in depth: protein, starch, lipids)
Density and pH	Temperature	Number of tillers/ears	Mineral composition	
Mineral composition and mobility	Radiation (intensity and duration)	Development rate	Digestibility	Mineral composition
Humidity and temperature	Disease pressure	Chlorophyll value		Enzyme activity and digestibility
Water retention capacity		Photosynthesis capacity		Rheology (starch, gluten)
Water gradient after irrigation		Stomatal potential		Water absorption capacity

Follow-up in function of time = time consuming

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RECAP

Major key concepts and take home messages

1. Experimental setup **appears to be easy** and straightforward but only when the research question is narrowed down.
    - **Drought stress** should be studied in a separate, analogous trial, keeping in mind the timing, intensity and duration of the drought.
2. Soil properties **influence various growth related factors**, thereby influencing plant development, thus altering the kernel composition.
    - **Plant responses** should be monitored to gain insight in their contribution to compositional differences.
    - **Moisture content** of the soil should be monitored **continuously** to prevent or control water stress.
3. It can be sunny in Belgium as well

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