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Agroscope

Evolution on cereal crops testing system

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Overview

Wheat: variety mixtures

- Market
- Results from ongoing research projects

Spelt: amendment of the regulation

- New regulation
- Results from ongoing research projects



Wheat: variety mixtures

Current situation in CH

Federal (national) regulations for inscription in the national & EU variety catalogue

- Components of the mixtures have to pass DUS test
- Mixture have to pass VCU test

Market situation

- 50% extensive production, 10% organic production
- The share of mixtures in the bread wheat market is currently only **1.6%** and is **subsidized** by a producer association that promotes integrated farming
- There is also interest from the **baking industry** to increase the share of variety mixtures in the bread wheat grain production
- Currently cultivated mixtures are composed of **already officially registered varieties** so they passed the official DUS/VCU tests (national & EU variety catalogue) & post inscription tests (list of recommended varieties)



Wheat: variety mixtures

Current situation in CH

Post inscription requirements for inscription

- Same rules for variety mixtures like for classic varieties **BUT**

Opposition to variety mixtures by seed multipliers (post inscription tests)

- the **seed multiplication organizations** were very much opposed to the cultivation of variety mixtures due to the risk of not being able to sell individual components that have only passed post inscription tests as a mixture but not individually
 - As a reaction single components are added to the **supplementary list** of recommended varieties to guarantee commercialization of all components both as a mixture and individually
 - For now mixtures will **not be composed by more than two** components
 - **Additional** laboratory (rheological and bread making) **tests** will be performed to define the 'quality class' of the individual components

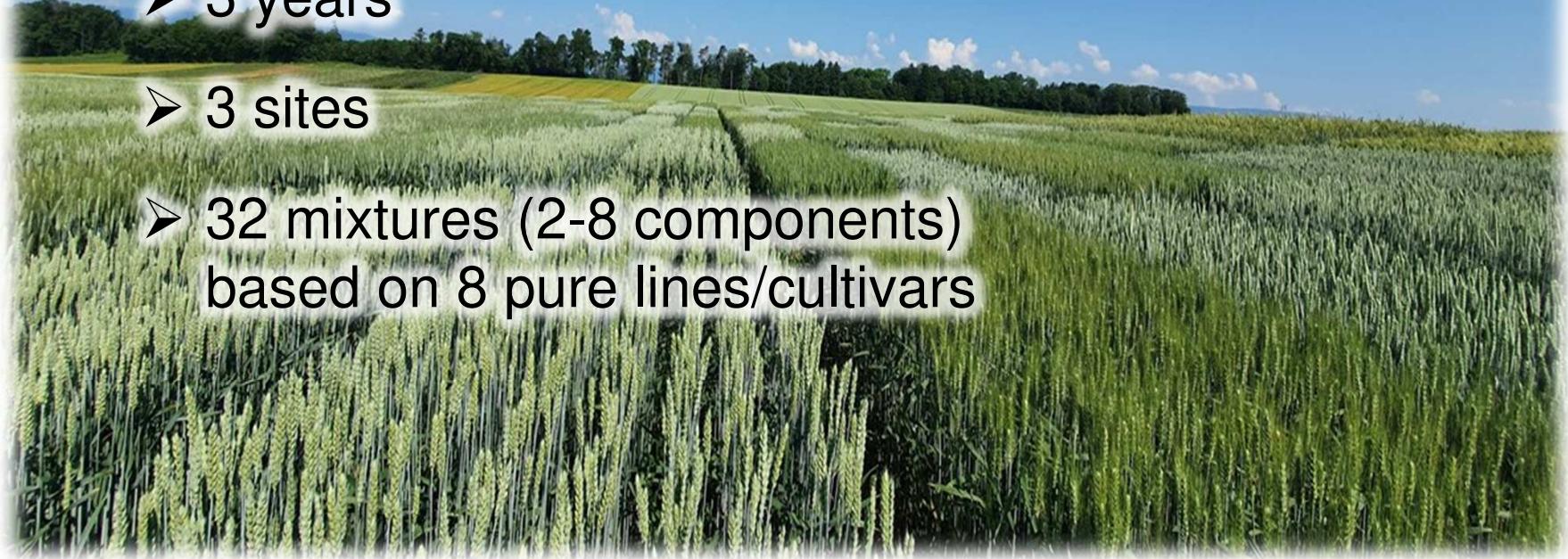


Wheat: variety mixtures

Results from ongoing research projects



- 3 years
- 3 sites
- 32 mixtures (2-8 components)
based on 8 pure lines/cultivars





Wheat: variety mixtures

Results from ongoing research projects



Results of the t-test to evaluate overperformance

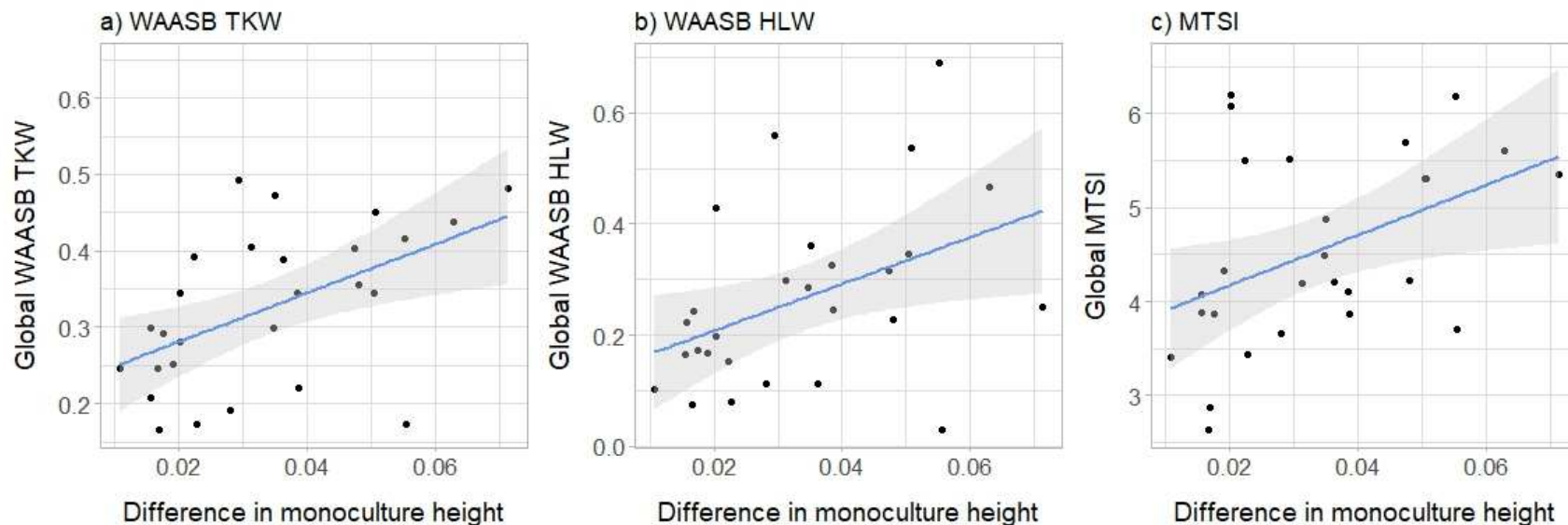
	<i>Changins</i>	<i>Delley</i>	<i>Utzenstorf</i>	<i>2021</i>	<i>2022</i>	<i>2023</i>	<i>Average</i>
<i>Overyield</i>	1.7	-0.9	-0.5	0.59	-0.34	-0.01	0.08
<i>Overprotein</i>	0.023	-0.3	-0.06	-0.17	-0.07	-0.1	-0.11
<i>OverTKW</i>	0.07	0.07	-0.056	-0.29	0.22	0.16	0.029
<i>OverHLW</i>	-0.55	0.016	0.095	0.078	-0.066	-0.44	-0.14
<i>OverZeleny</i>	-0.15	1.5	1.86	0.035	2.18	1.03	1.08
<i>OverLAI early</i>	0	NA	NA	0.03	0.14	-0.07	0
<i>OverLAI late</i>	0.3	NA	NA	0.55	0.035	0.14	0.3

- Significant differences: ▲ (positive) ▼ (negative)
- Overperformance of mixtures strongly dependent on enviromental conditions (site & year)
- Postive effect strongest for Zeleny and late leaf area index ▲



Wheat: variety mixtures

Results from ongoing research projects



Global stability trait scores for **thousand kernel weight (TKW)**, **test weight (HLW)** and **Global Multitrait Stability Index (MTSI)** of mixtures in relationship to difference in pure variety height (n=28)

➤ The less difference in height the more stable!



Wheat: variety mixtures

Results from ongoing research projects



Conclusion

- Variety mixtures are better than pure stands in terms of global performance & stability (grain yield, protein content, TKW, HLW, and Zeleny sedimentation rate)
- Crucial role of light interception in the design of the mixtures: higher light interception = better mixture performance
 - Recommendations: Plant height (low difference between components), ear density (high difference between components) and LAI (higher = better)



Spelt: amendment of the regulation

New regulation



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Spelt: amendment of the regulation

New regulation

Market situation

- 2 varieties (inscription year 1948 resp. 1978) commercialized as PureSpelt (UrDinkel/PureEpeautre) by a 'interest group' dominate largely the market

Problems

- Varieties are highly low yielding, susceptible to diseases and lodging

Challenges

- Preservation of quality of ancient spelt (no or little crossing with modern wheat varieties) while improving its agronomic performance (disease resistance, etc.)

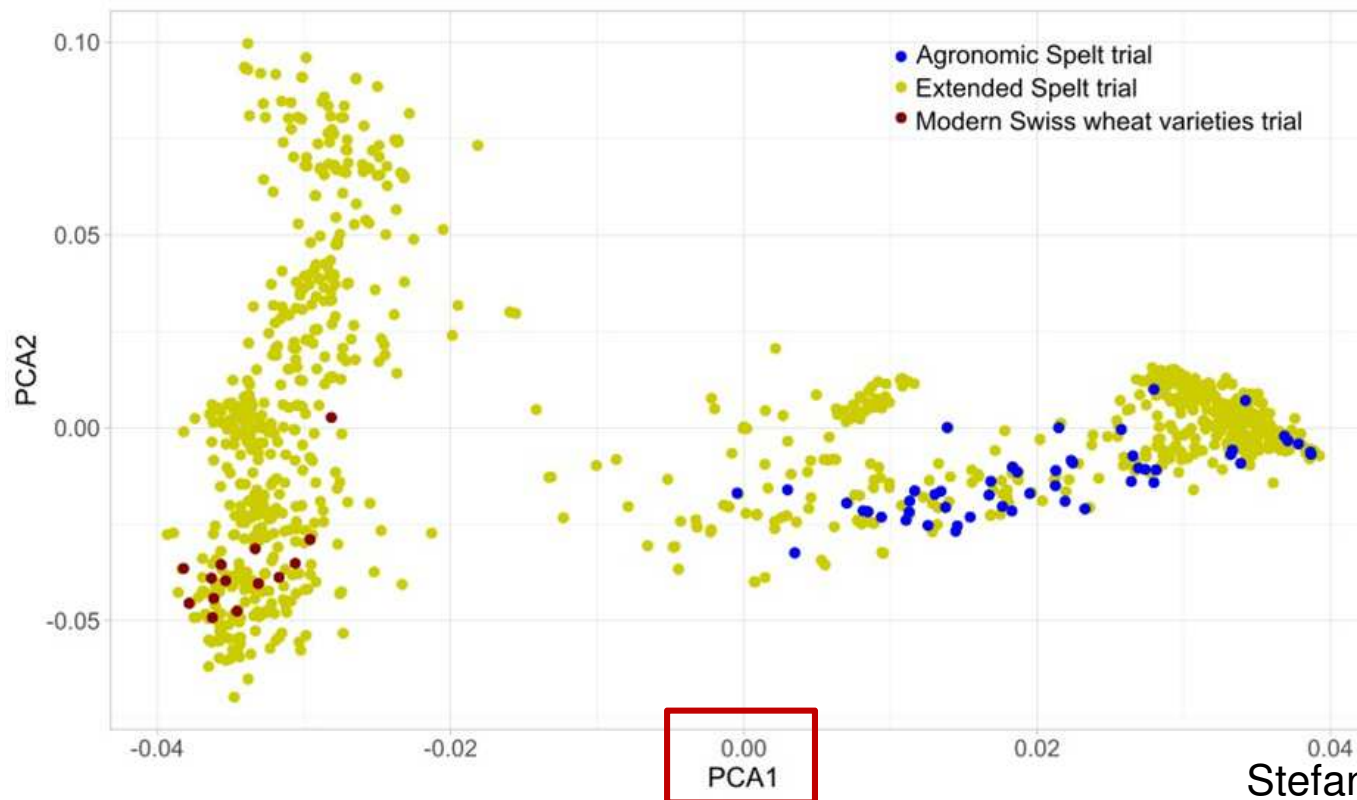
- **Updated regulation on spelt variety inscriptions includes a correction factor for spelt typicity**



Spelt: amendment of the regulation

New regulation

- Spelt VCU value corrected for 'spelt-typicity'
- Correction factor based on genetic analysis (1st principal component x-axis) of 400+ accessions from traditional spelt to modern wheat cultivars



Stefan et al. 2024



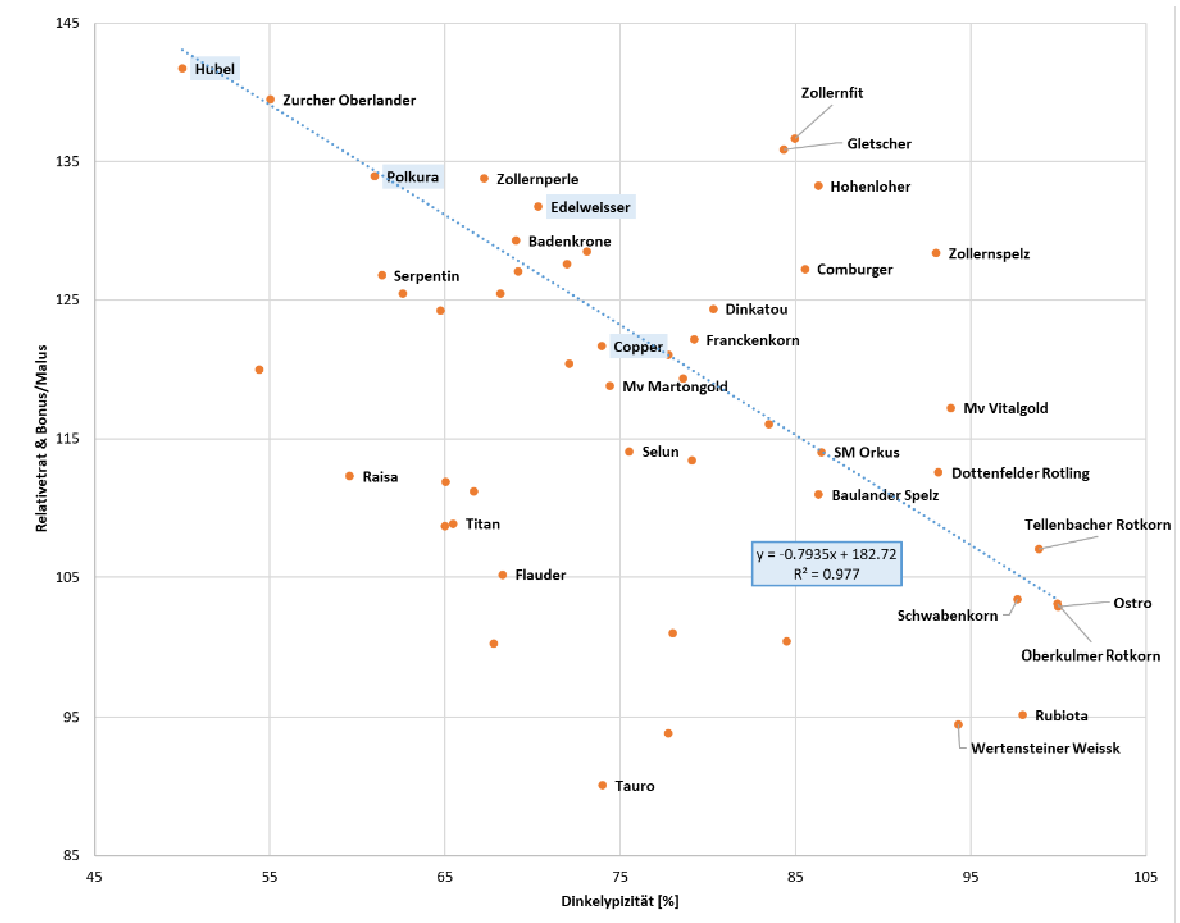
Spelt: amendment of the regulation

New regulation

Spelt typicity
based on 1st PC
(400+ sequenced
accessions) *x-axis*

Correction based
on **linear**
regression of
reference varieties

Cultivar VCU-
value on *y-axis*





Spelt: amendment of the regulation

Results from research projects

- 2 years
- 3 sites
- 50 varieties

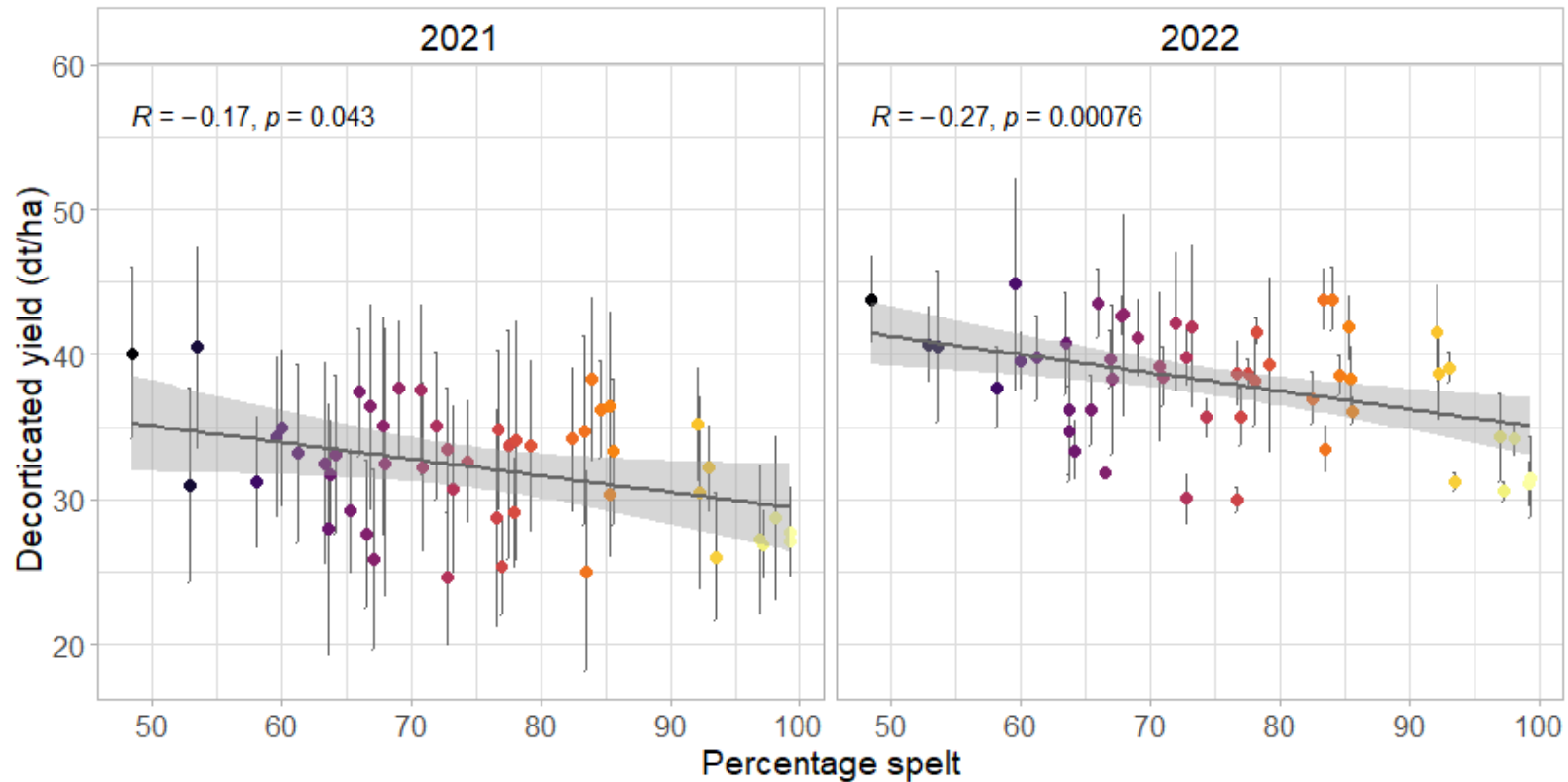




Spelt: amendment of the regulation

Results from research projects

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$n = 150$ per year. Dots represent the mean values across replicates and sites; lines represent the standard error.

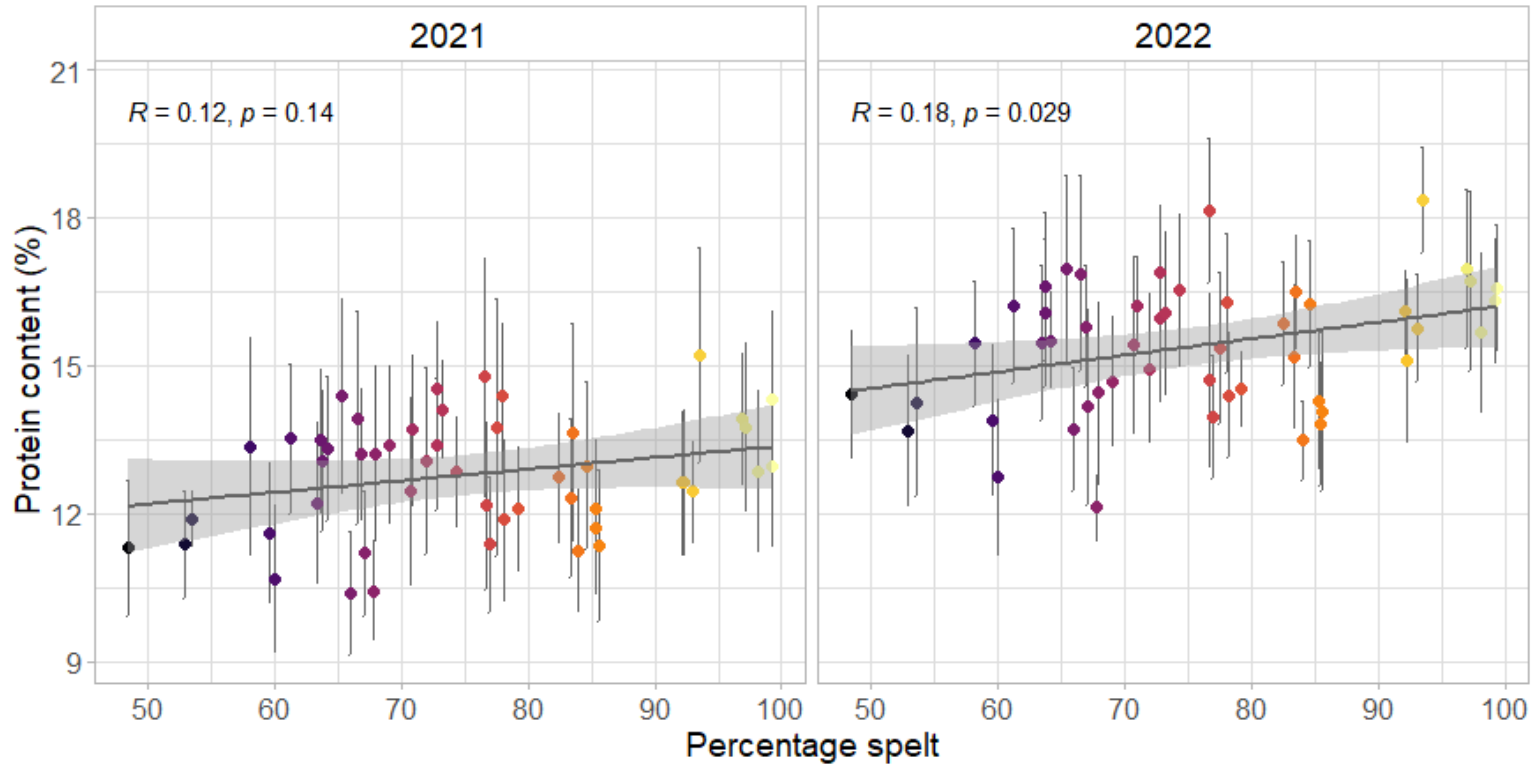
The grey lines represent linear regression fittings, with the grey area representing the 0.95 confidence interval.



Spelt: amendment of the regulation

Results from research projects

Stefan et al. 2024



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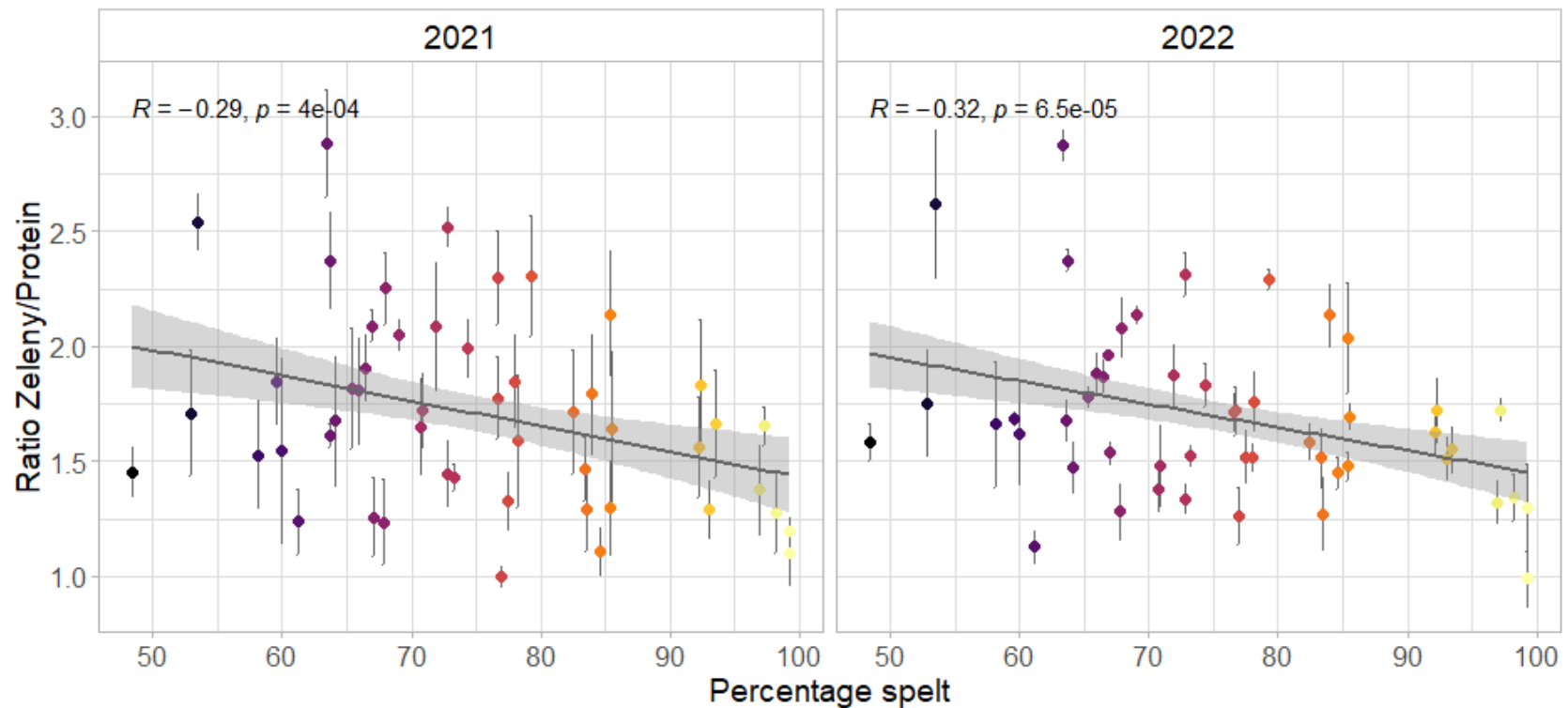
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Spelt: amendment of the regulation

Results from research projects

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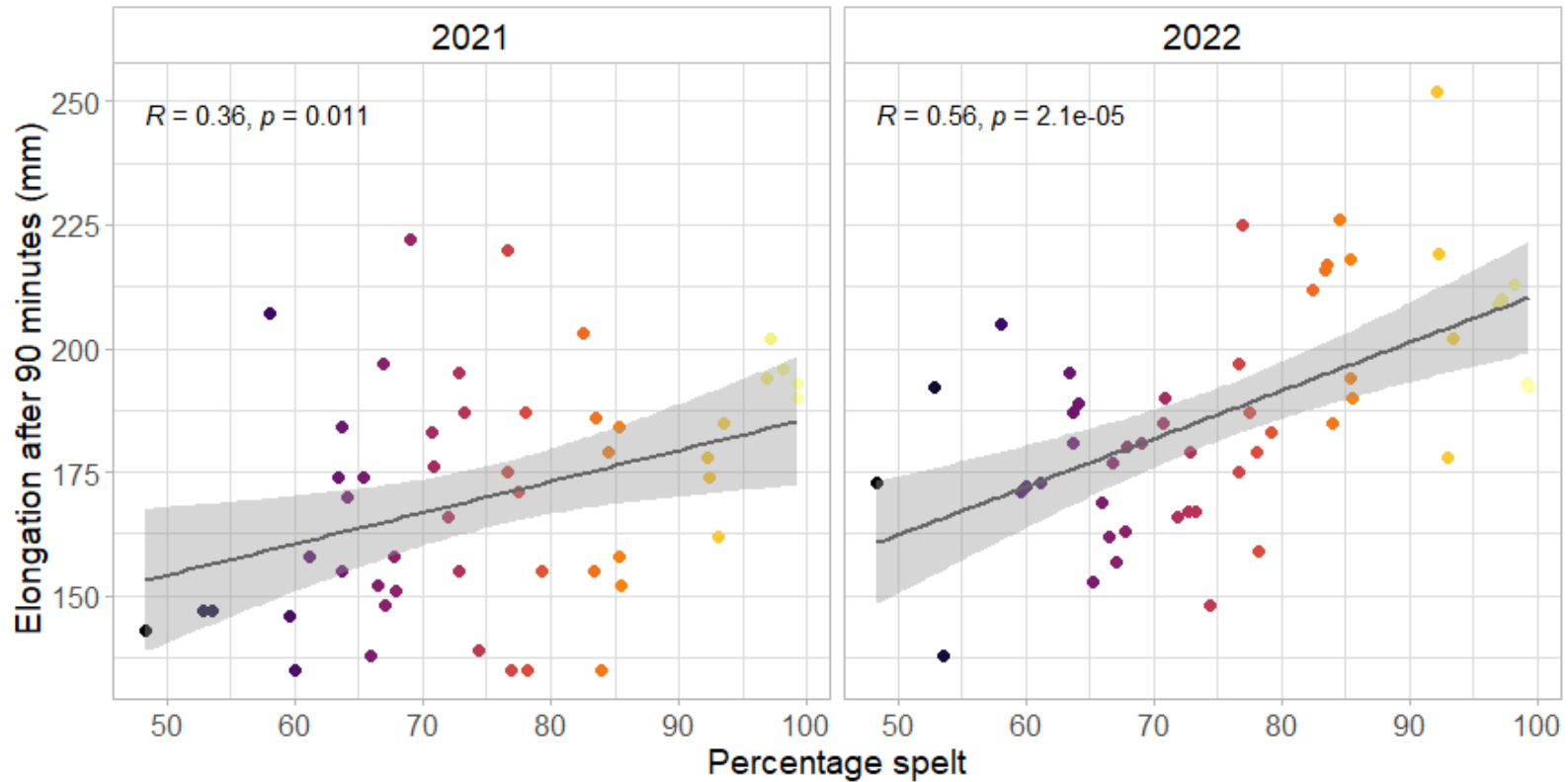




Spelt: amendment of the regulation

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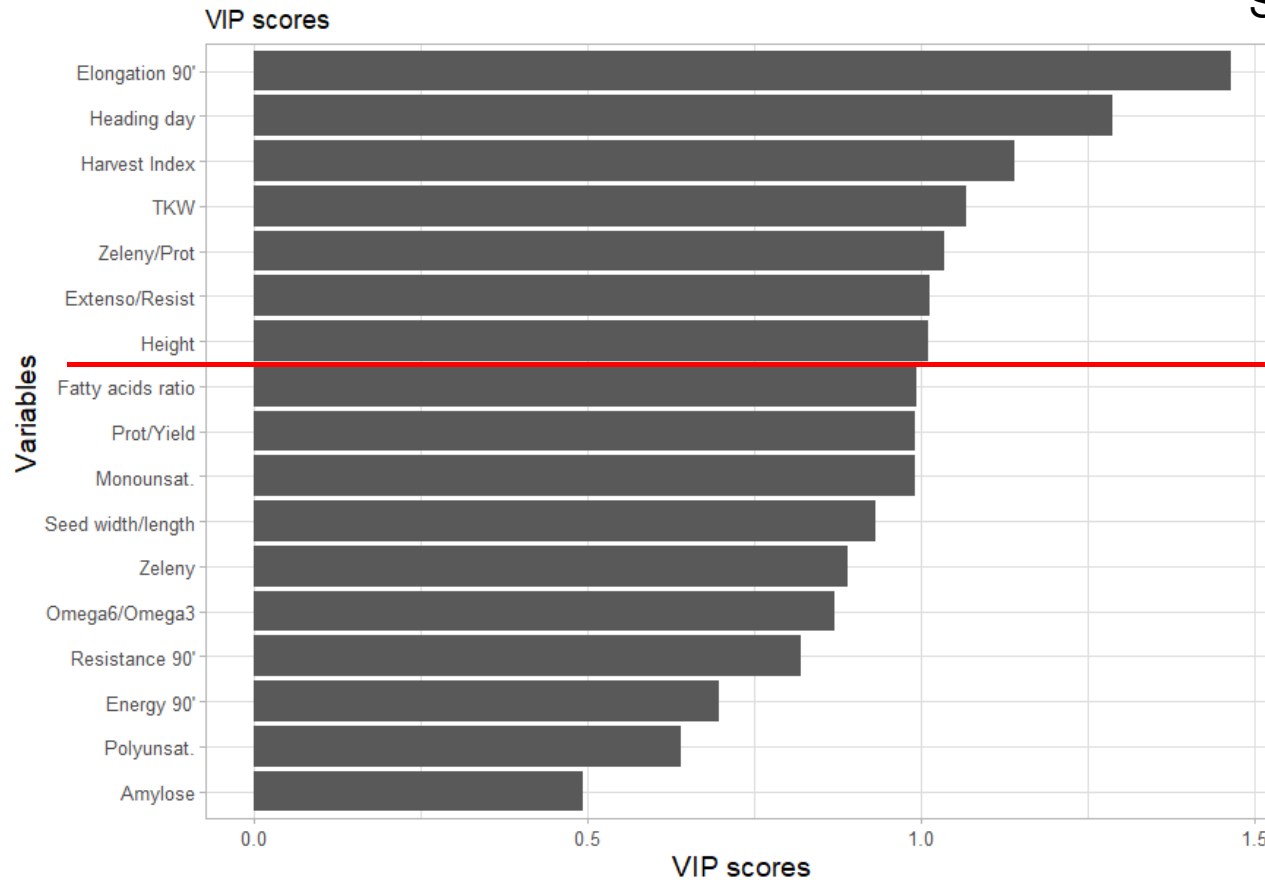




Spelt: amendment of the regulation

Results from research projects

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VIP >1: significant explanatory variable



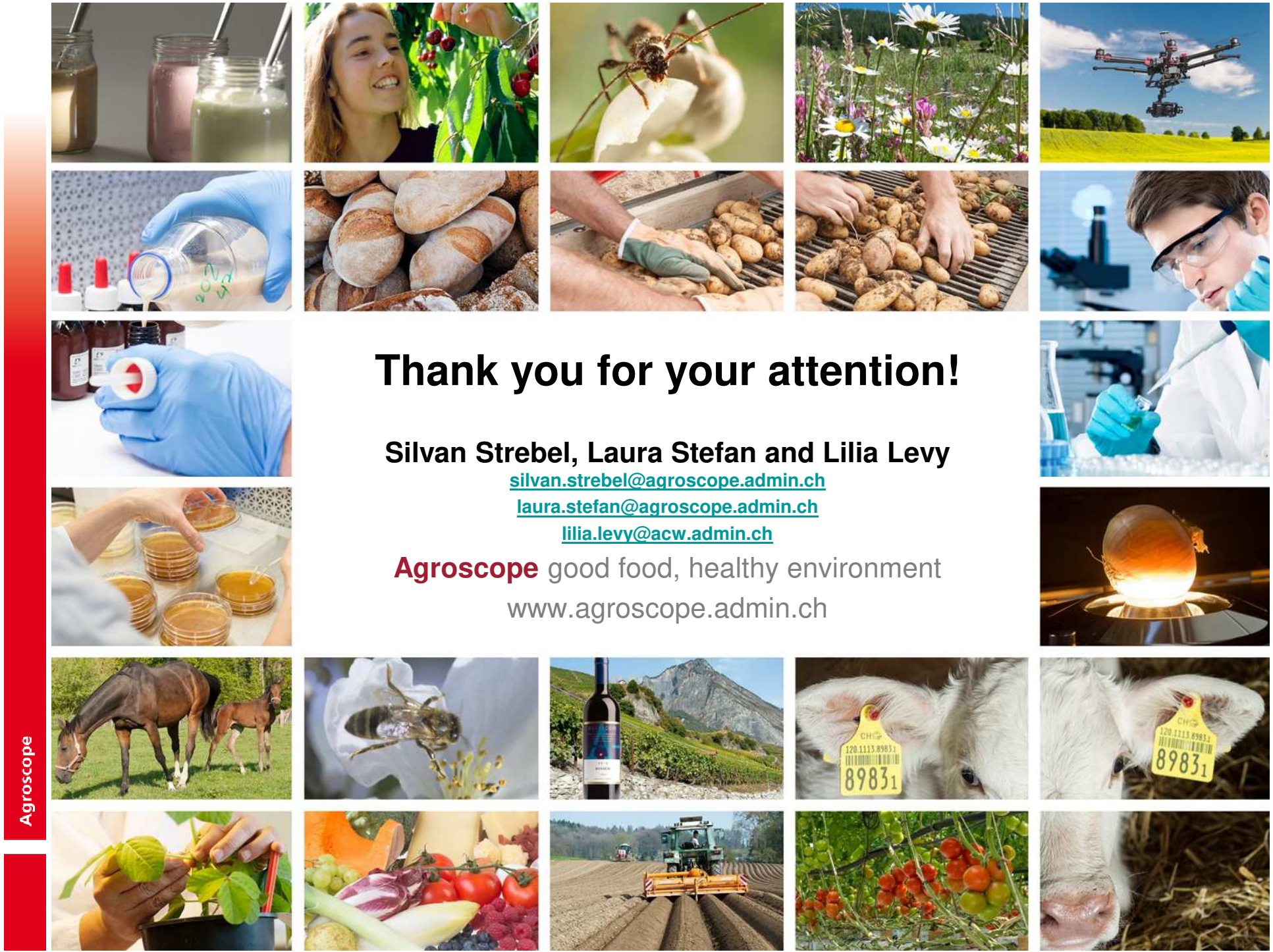
Spelt: amendment of the regulation

Results from research projects

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Conclusion

- Separation of modern wheat and traditional spelt landraces based on genetic sequencing (SNPs) is possible.
- Typical spelt varieties were characterized by highly extensible doughs, later phenology, low harvest index, high thousand kernel weights, and lower Zeleny/protein ratio.



Thank you for your attention!

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References

- Stefan, L., Sanchez-Martin, J., Kurth, T., Keller, B., Herren, G., Krattinger, S. G., ... & Häner, L. L. (2024). A genotype-phenotype approach to discriminate Central European spelt landraces from modern wheat-spelt intercrosses in the Swiss context.



Criteria for bread wheat quality classes

Inscription requirements for CH national catalogue

	Quality	Agronomic index
	Indice Qtechno requis (points)	Indice agronomique requis (points)
Top	> 130	> 95
I	110 à 130	> 103
II	80 à 110	> 110
Fourrager	≤ 80	> 120
Biscuit	Critères spécifiques	> 110

Inscription requirements for post inscription (list of recommended varieties)

	Quality	Wet gluten%	Agronomic index
	Indice Qtechno requis (points)	Teneur en Gluten humide % (cultivés en PER)	Indice agronomique requis (points)
Top	> 130	≥ 31%*	> 95
I	110 à 130	≥ 29%*	> 103
II	95 à 110	≥ 27%*	> 110
Fourrager	≤ 80		> 120
Biscuit	Critères spécifiques		> 110