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Approaches under evaluation for a more precise recommendation of varieties



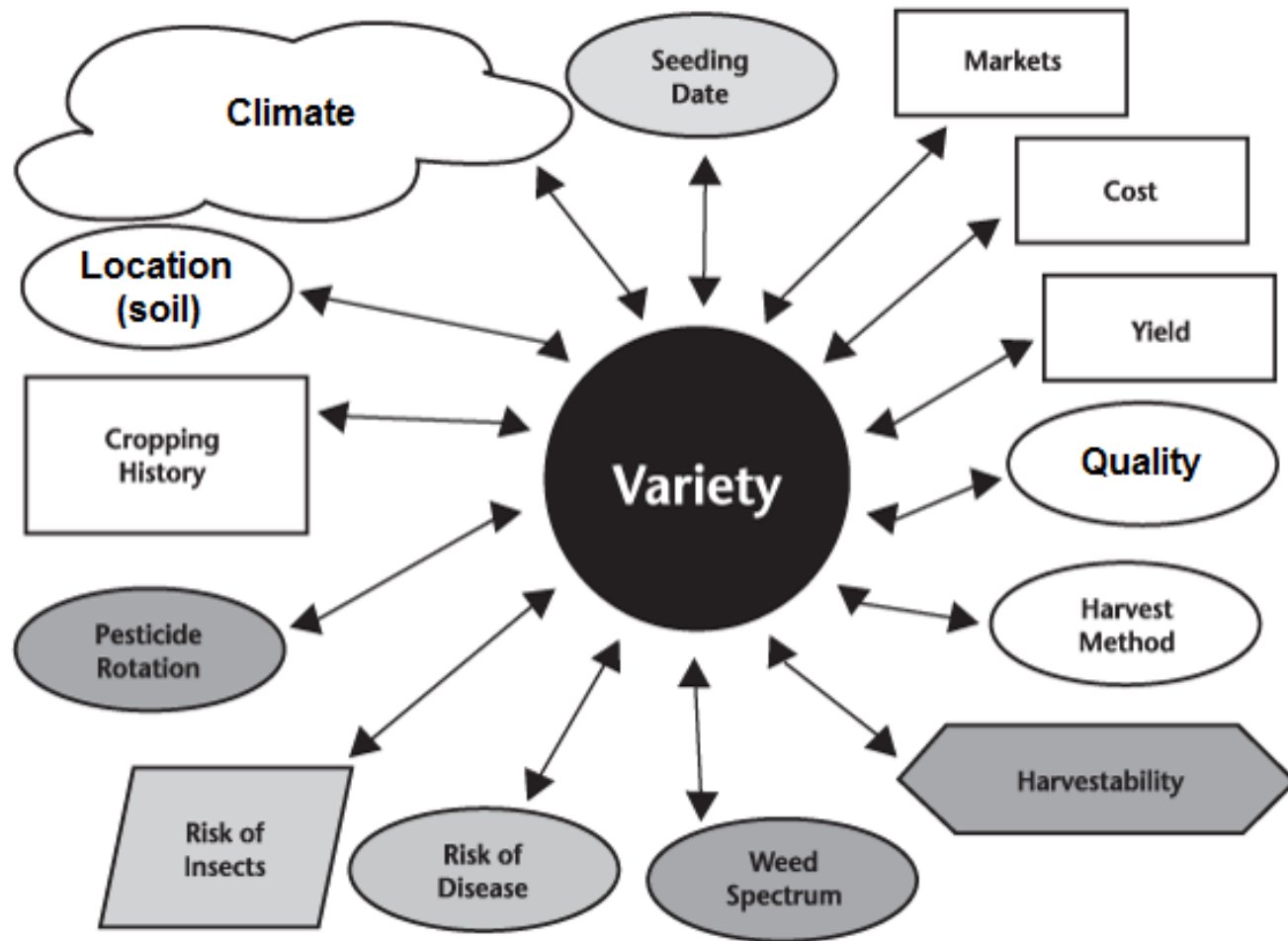
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Agroscope**

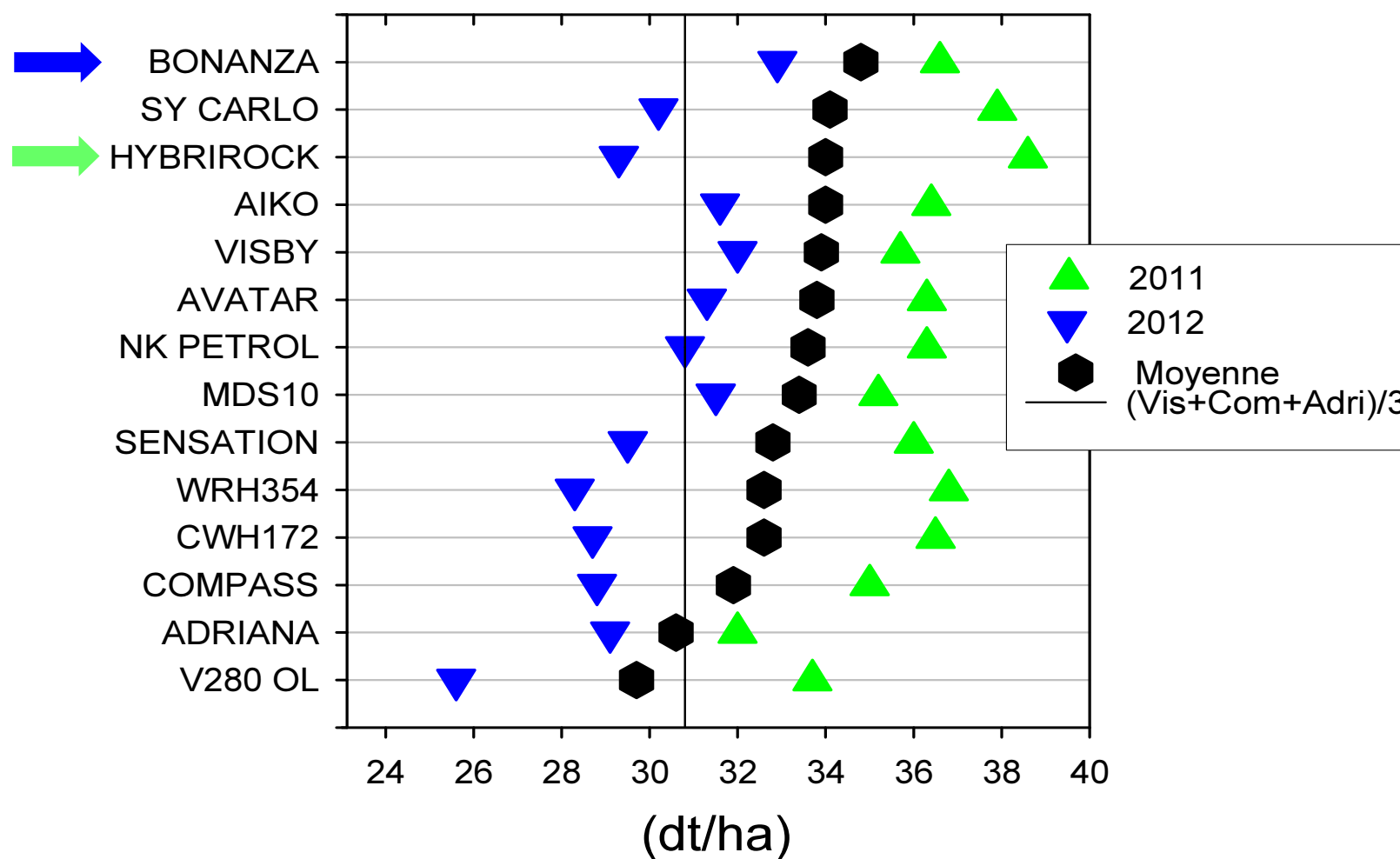
www.agroscope.ch | good food, healthy environment

Morat, January 2016

Criteria for choosing a variety



Ranking of winter oilseed rape varieties according to grain yield and influenced by year



Genotype × Environment interaction (G × E) (Variety trials of winter oilseed rape 2013-2014)

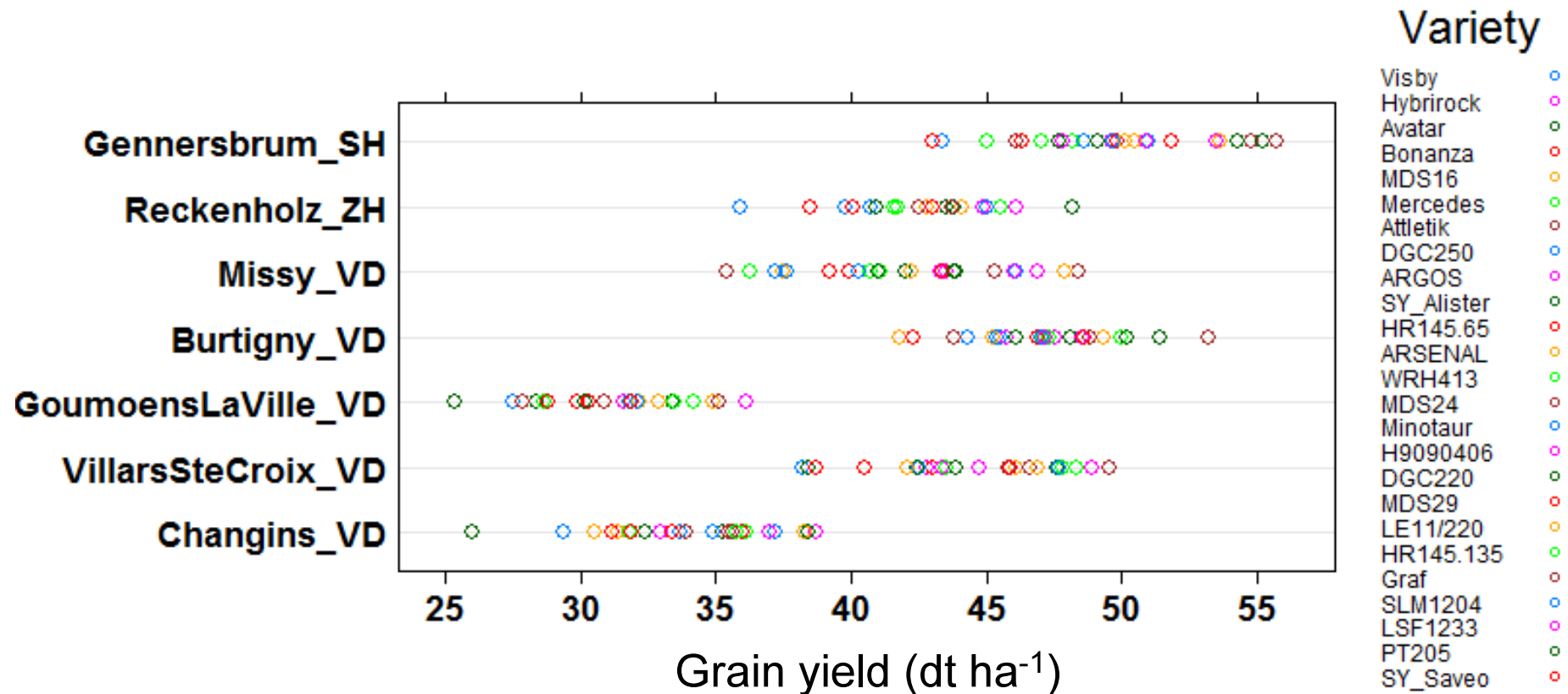
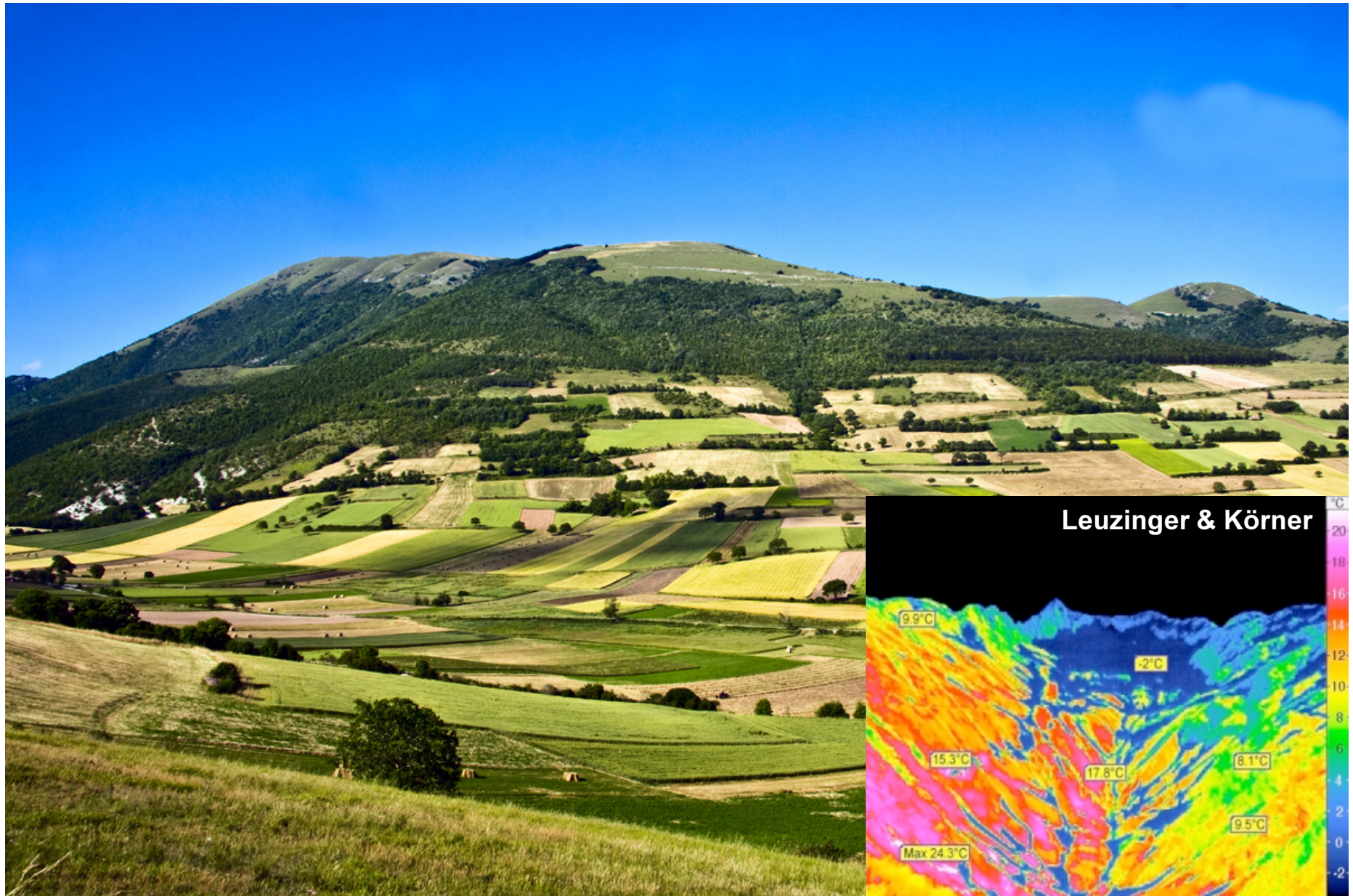


Tableau 1 | Liste recommandée des variétés de colza d'automne pour la récolte 2016

Type	Variétés classiques						Variétés HOLL	
	Hybrides restaurés (H.r.)						H. r.	
Variété ^a	VISBY	HYBRIROCK	AVATAR	BONANZA	SY CARLO	ATLETICK	V2800L	V3160L
Année d'inscription	2008	2012	2012	2014	2014	2015	2011	2014
Précocité à la floraison	mp	mp	p	mt	p	mp	mp	mp
Précocité à maturité	mp	mp	mp	mt	mp	mp	mp	mp
Rendement en grains	++	++	+++	+++	++	+++	+	+++
Teneur en huile	++	+	+++	++	++	++	+	++
Verse	+++	++	+++	+++	++	++	++	+++
Nécrose du collet (Phoma lingam)	+	+++	+	+++	++	++	+	+++
Sclerotiniose (Sclerotinia sclerotiorum)	++						++	

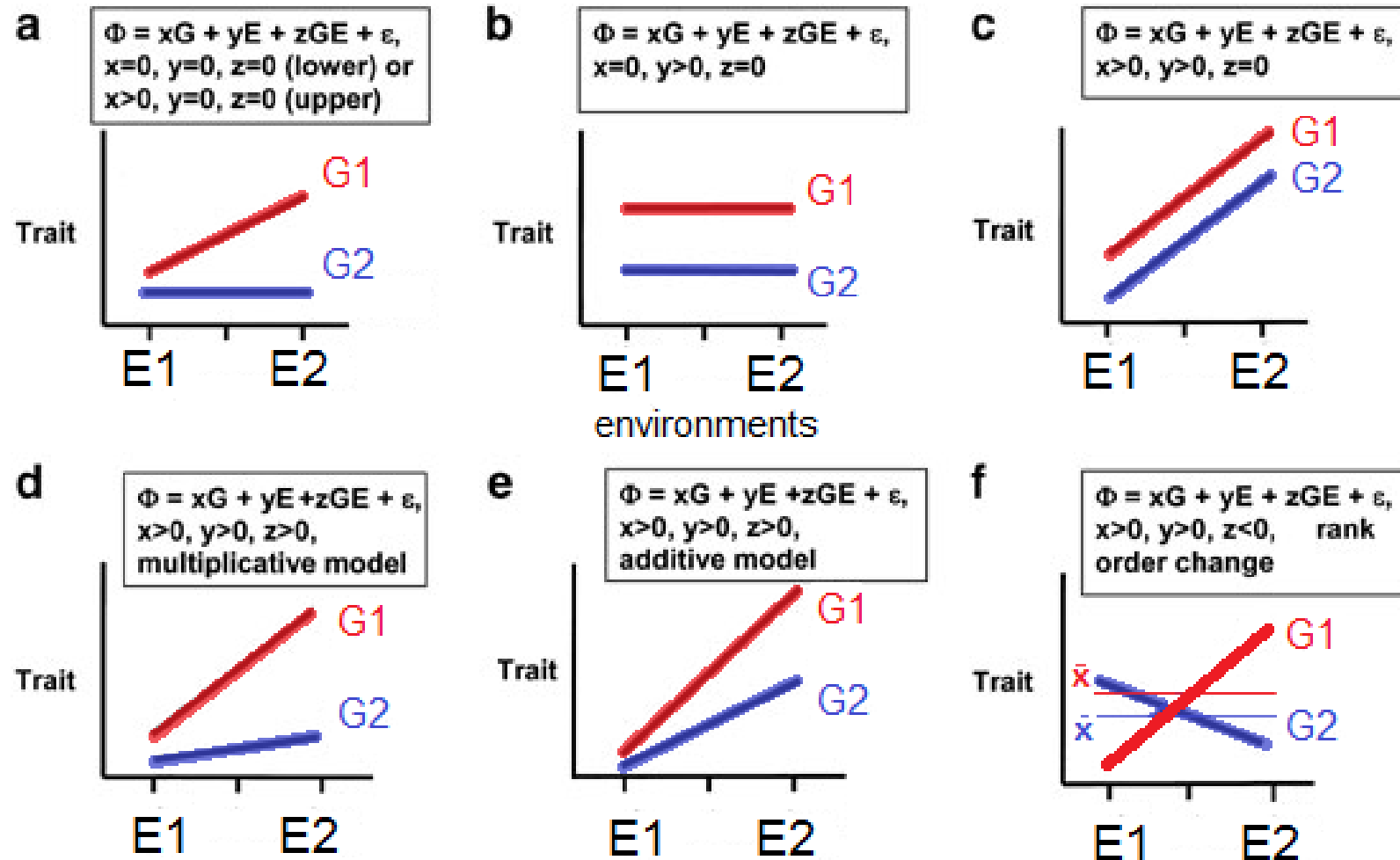
Towards site-specific variety recommendations



Importance of G×E (as percentage of total variance)

Crop	Environment (%)	Genotype (%)	G×E (%)	Study
Sugar beet	85	7	7	Richard et Lassalvy 2013
Bread wheat	75	8	15	Menad 2011 / Lecompte 2005
Oilseed rape	85	4	7	Bagot 2012 / Terres Inovia
Sunflower	63	12	11	Casadebaig 2008 / Terres Inovia
Coton	80	9	12	Baxevanos et al. 2008
Maize (grain)	80	10	10	Epinat-Le Signor et al. 2001
Chickpeas	60	8	23	Dehghani 2010
Rice	57	20	18	Courtois 2010 / Blanche et al. 2009

Practical and analytical implications of $G \times E$



Methods for $G \times E$ analysis

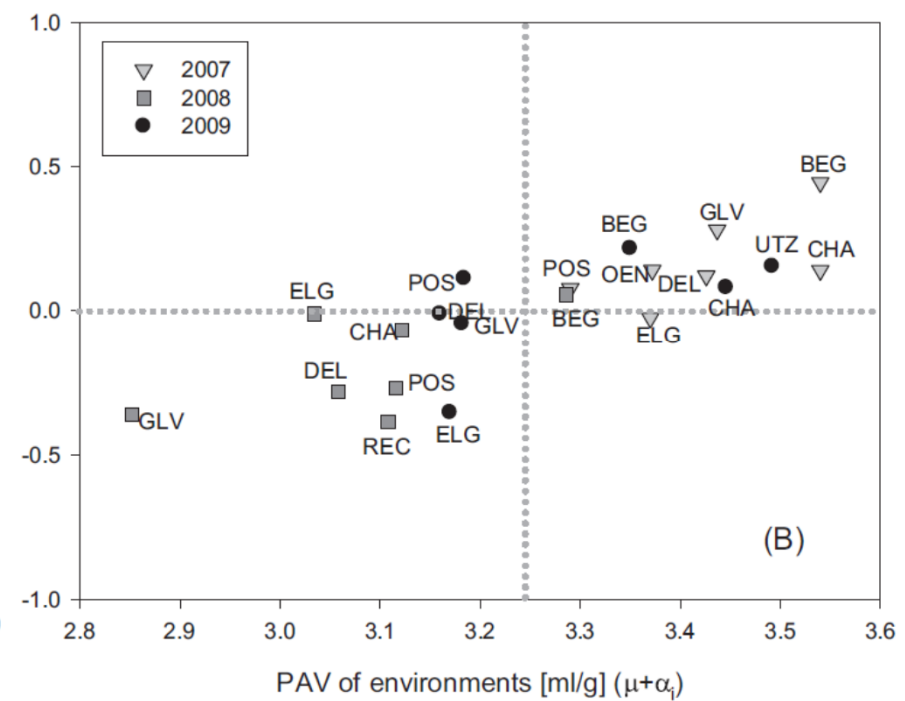
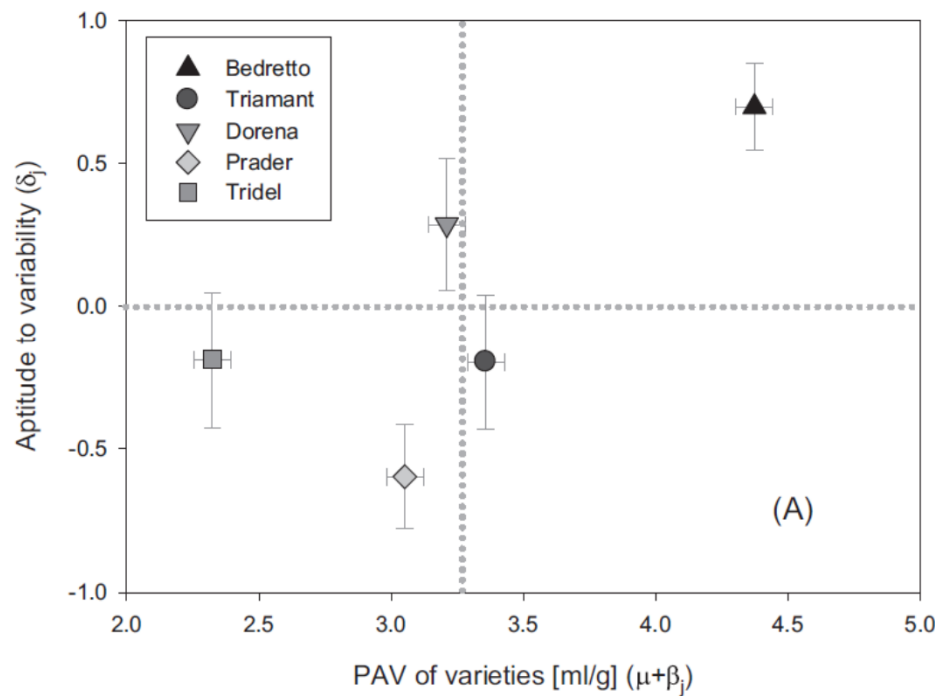
Type	Method
Parametric univariate	Variance (Roemer 1917, Francis and Kannenberg 1978) Regression (Finlay and Wilkinson 1963, Eberhart and Russel 1966, Tai 1971) ANOVA - $G \times E$ interaction (Wricke 1962, Shukla 1972, Lin and Binns 1988)
Non-parametric univariate	Hühn 1979, Kang 1988, Ketata et al. 1989, Fox et al. 1990, Flores 1993
Multivariate	First approaches (Sokal and Michener 1958, Gadheri et al. 1980, Lin 1982, Fox and Rosielle 1982, Westcott 1987, Lopez 1990, Yan et al. 2000) AMMI (Zobel et al. 1988) SREG (Cornelius et al. 1996) Biplots (Cossa 2000) Factorial regression (Balfourier 1997) PLS regression (Dimauro 2013) Random Forest (Sarkar 2015)

Extrapolation to “unobserved” sites

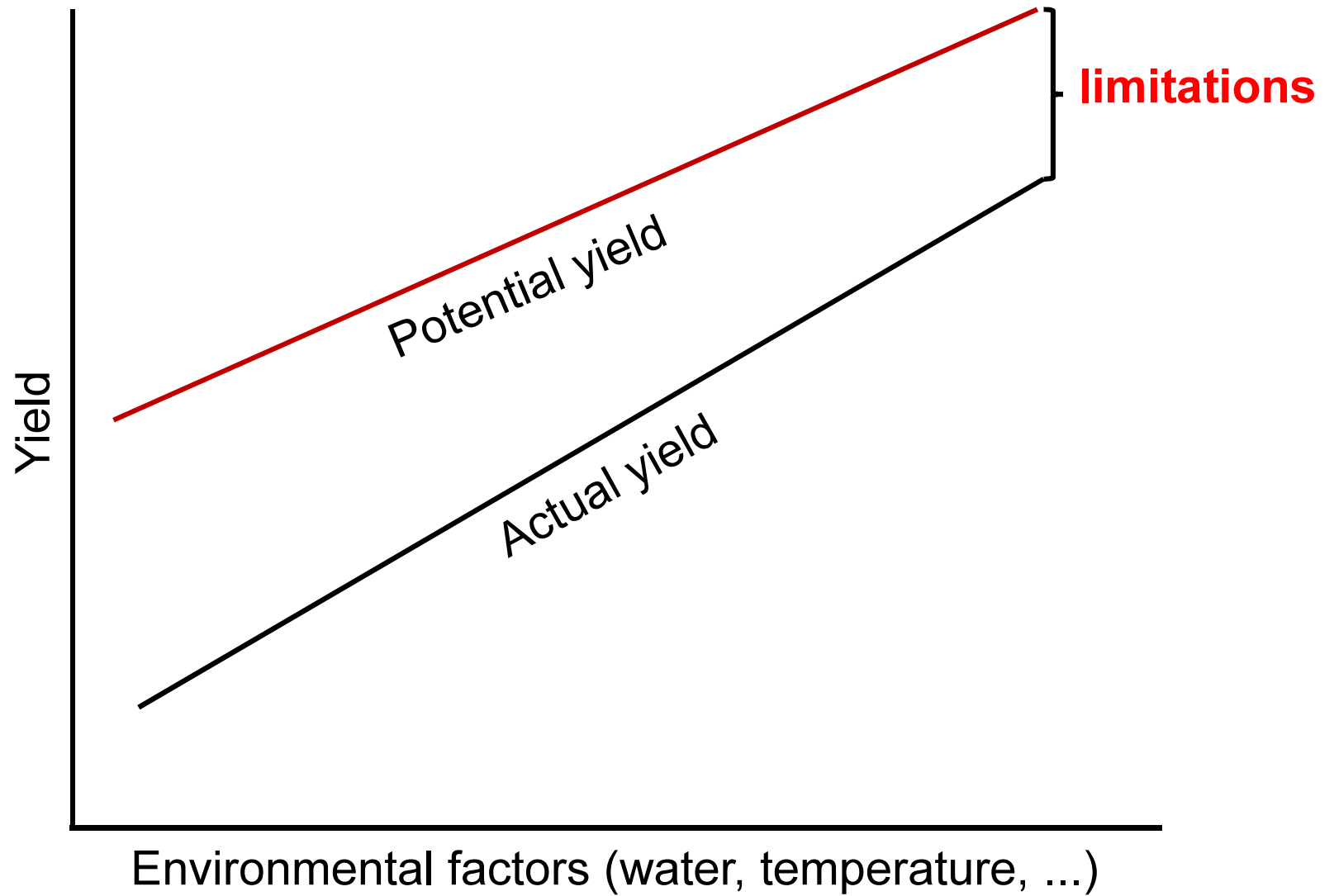
$$Y_{ijk} = \mu + G_i + \boxed{E_j} + \boxed{G \times E_{ij}} + \varepsilon_{ijk}$$

$$\alpha_1 \cdot X_{1j} + \dots + \alpha_n \cdot X_{nj} + E'_j$$

$$\beta_{1i} \cdot X_{1j} + \dots + \beta_{ni} \cdot X_{nj} + G \times E'_{ij}$$

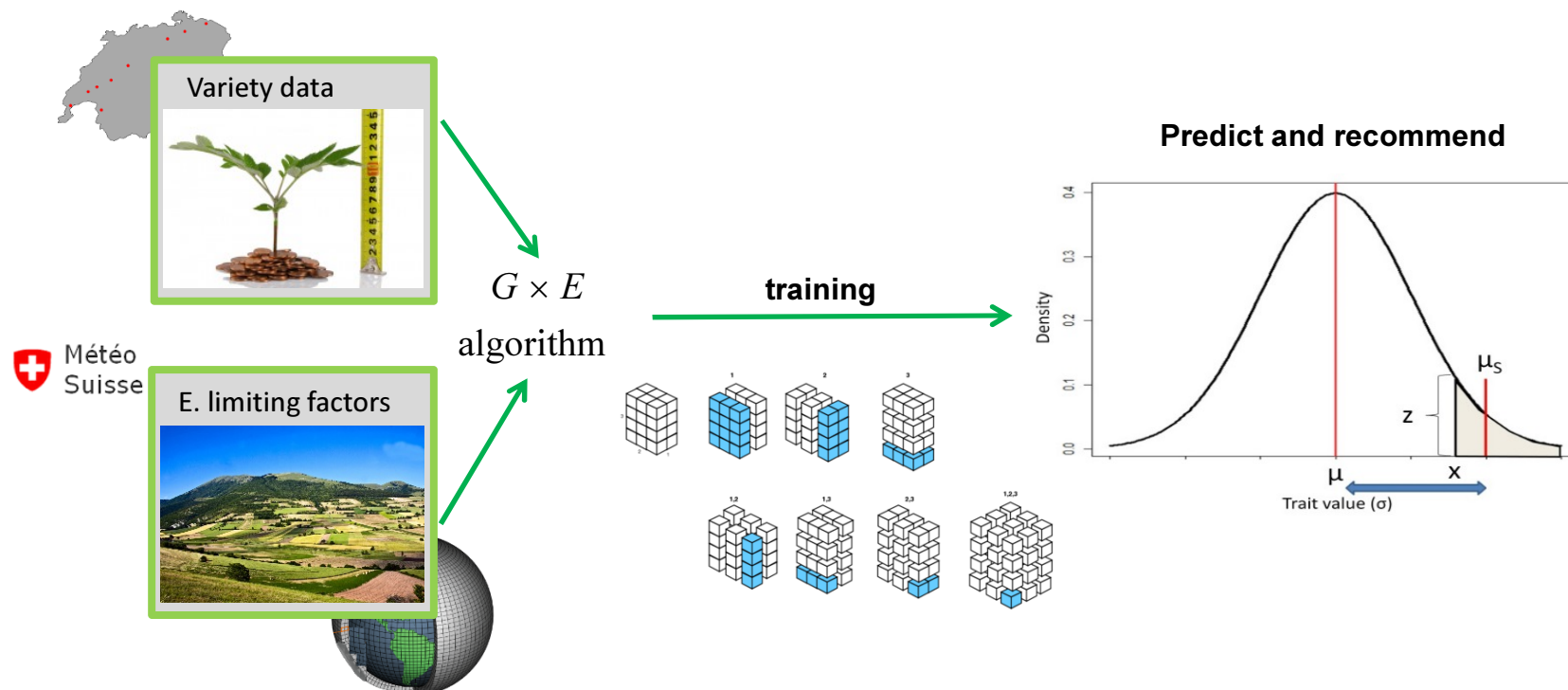


Identification of limitations using crop models



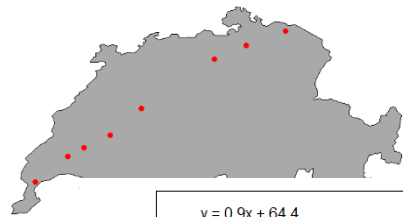
Prediction of genotype performance at specific sites

- ✧ Genotype characterization from variety trials.
- ✧ Environmental characterization of 10000 sites (4 km² each) by limiting factors.
- ✧ Simulates the performance of each genotype as a function of the limiting factors.
- ✧ Can identify from the training dataset the best performing genotype at each site.

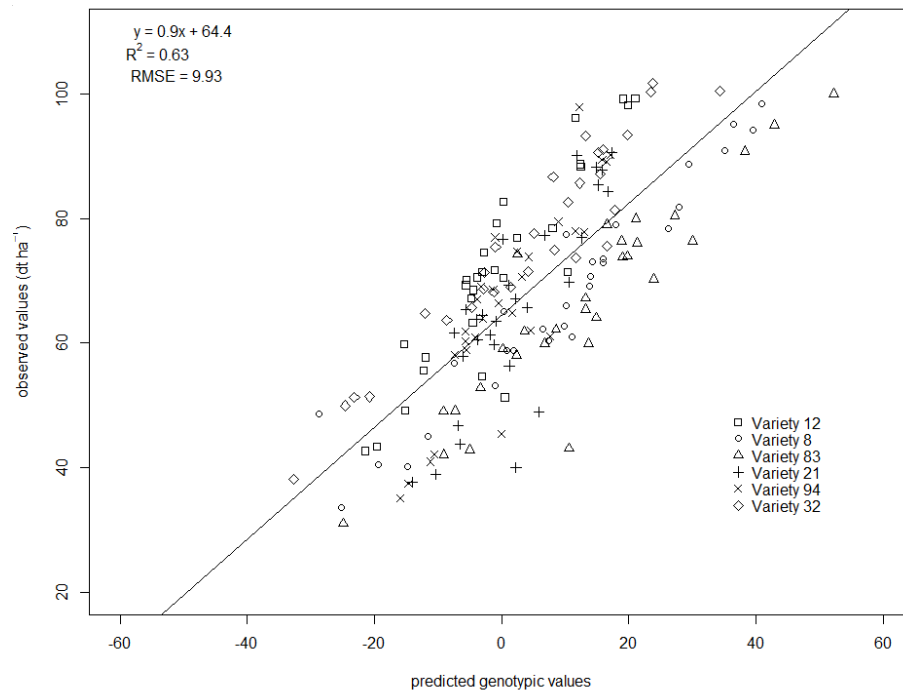


Evaluation and validation of the algorithm

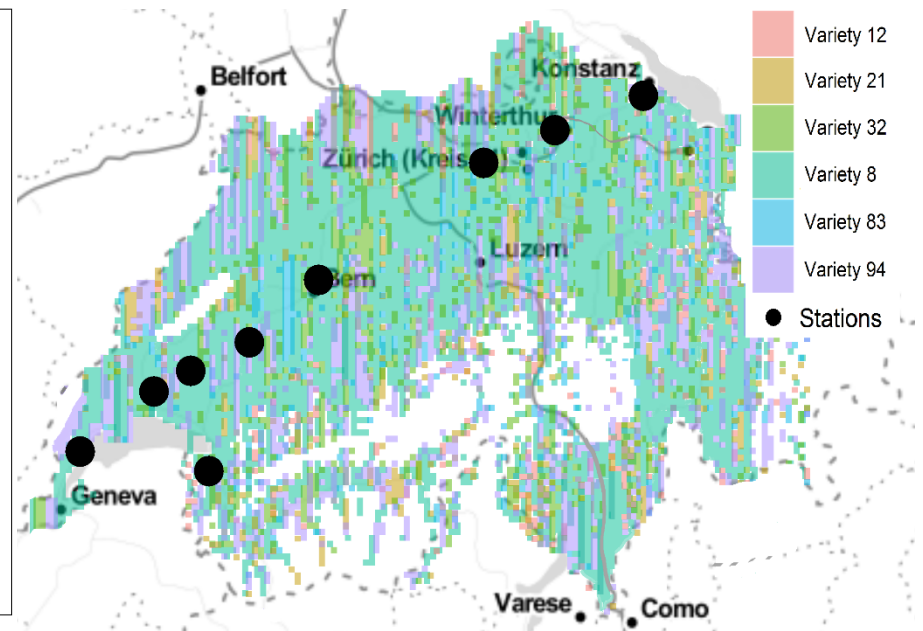
Winter wheat - WW40 results



Validation



Recommended varieties for 10000 sites



Current status and next steps

- Current status

- ✓ Crop model $\rightarrow$ G $\times$ E algorithm $\rightarrow$ Geostatistical model coupled.
- ✓ Statistical validation.
- ✓ Final results to plot maps with better software (e.g. Arcview).
- ✓ Article in preparation.

- Next steps

- Field validation.
- Improve prediction power.
- Identify and add additional environmental limitations
 - Soil
 - Nitrogen availability
- Consider other traits (e.g. Quality).
- Extent the approach to other crops.



Thank you



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