

Supplementary material for: Unravelling the Complexities of Genotype-Soil- Management Interaction for Precision Agriculture

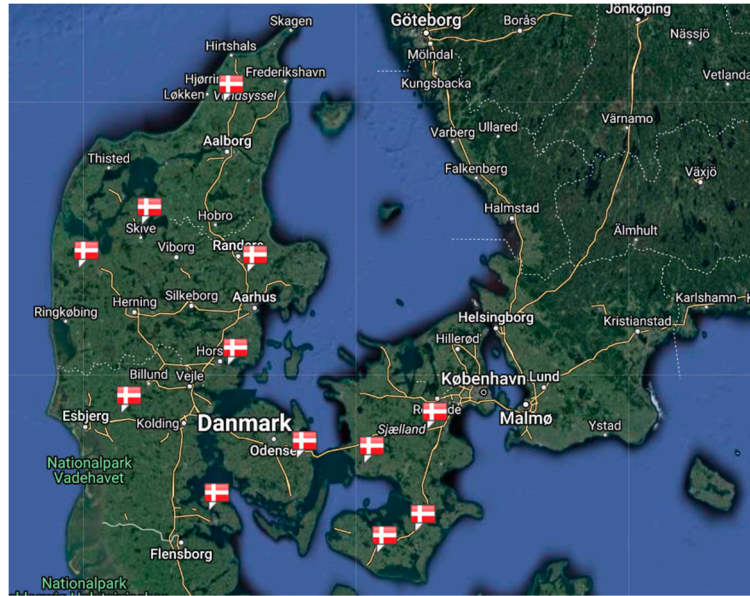


Figure S1: Locations of testing trials in Denmark

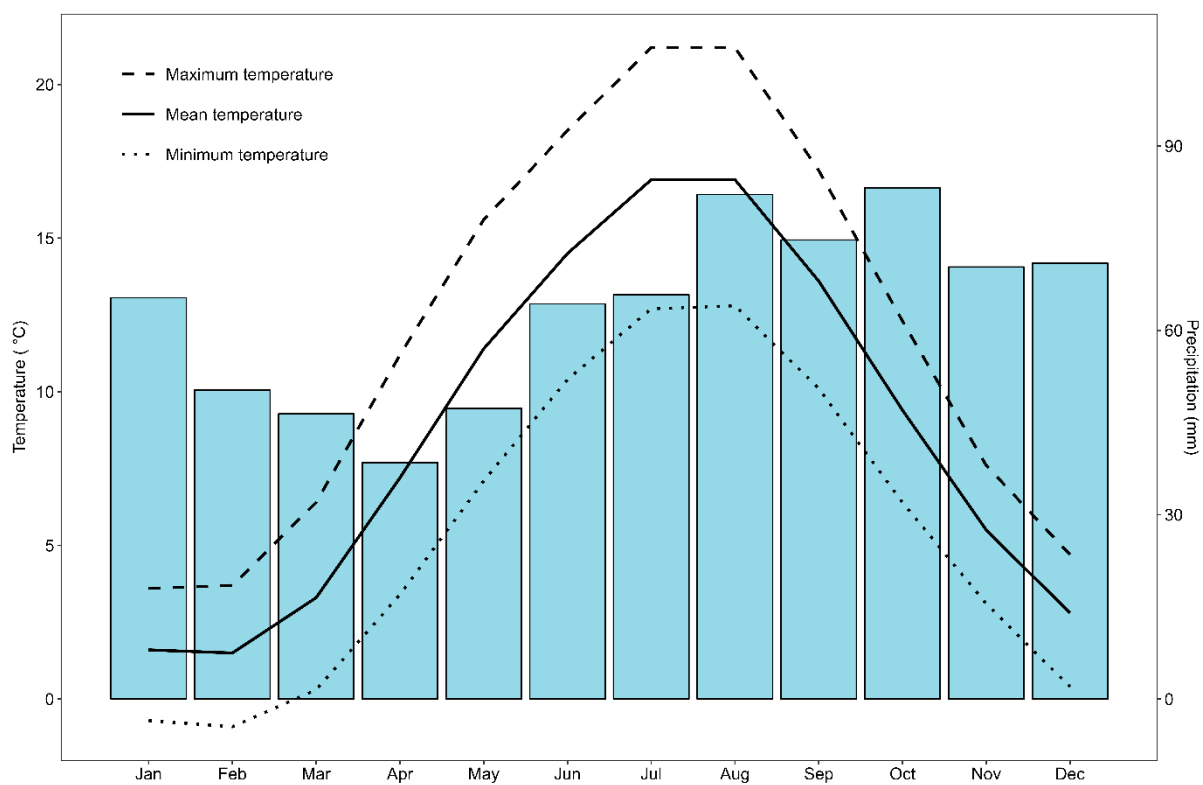


Figure S2: Climate normal in Denmark 1991-2021. The National Danish Meteorological Institute (Klimanormaler Danmark (dmi.dk)).

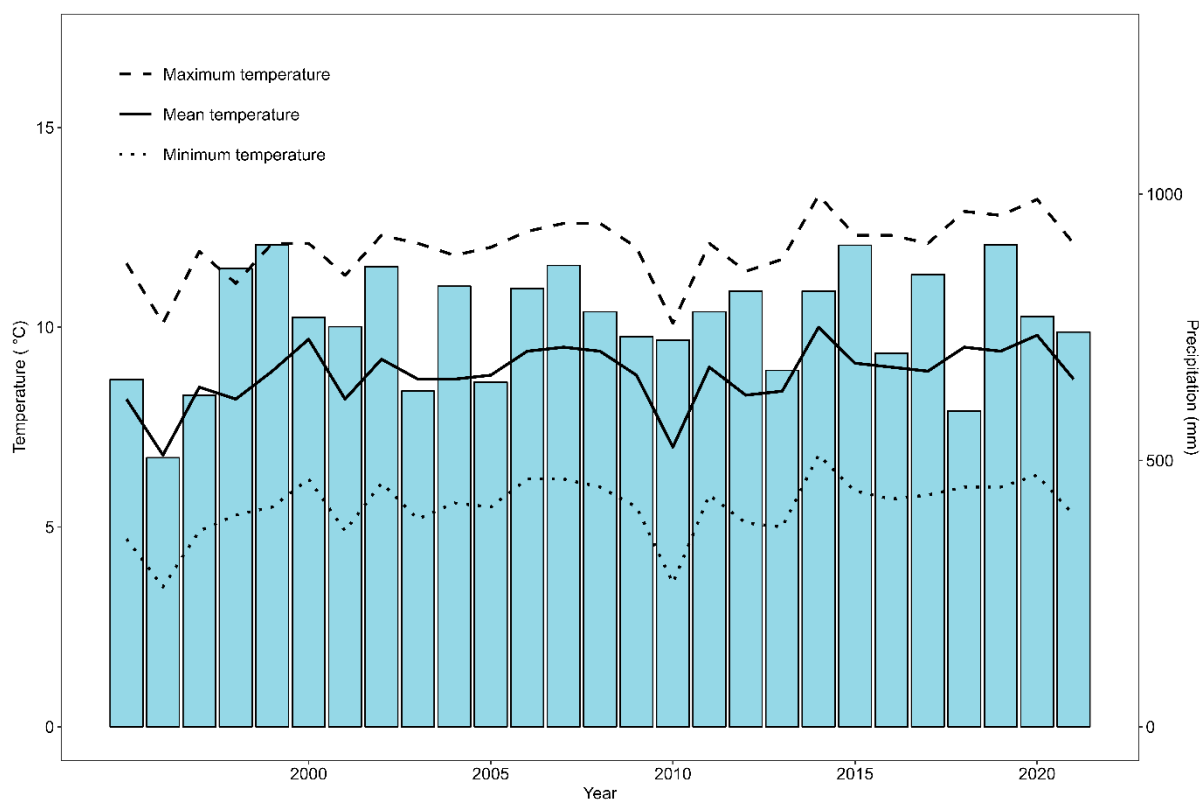


Figure S3: Weather data for Denmark 1997-2021.

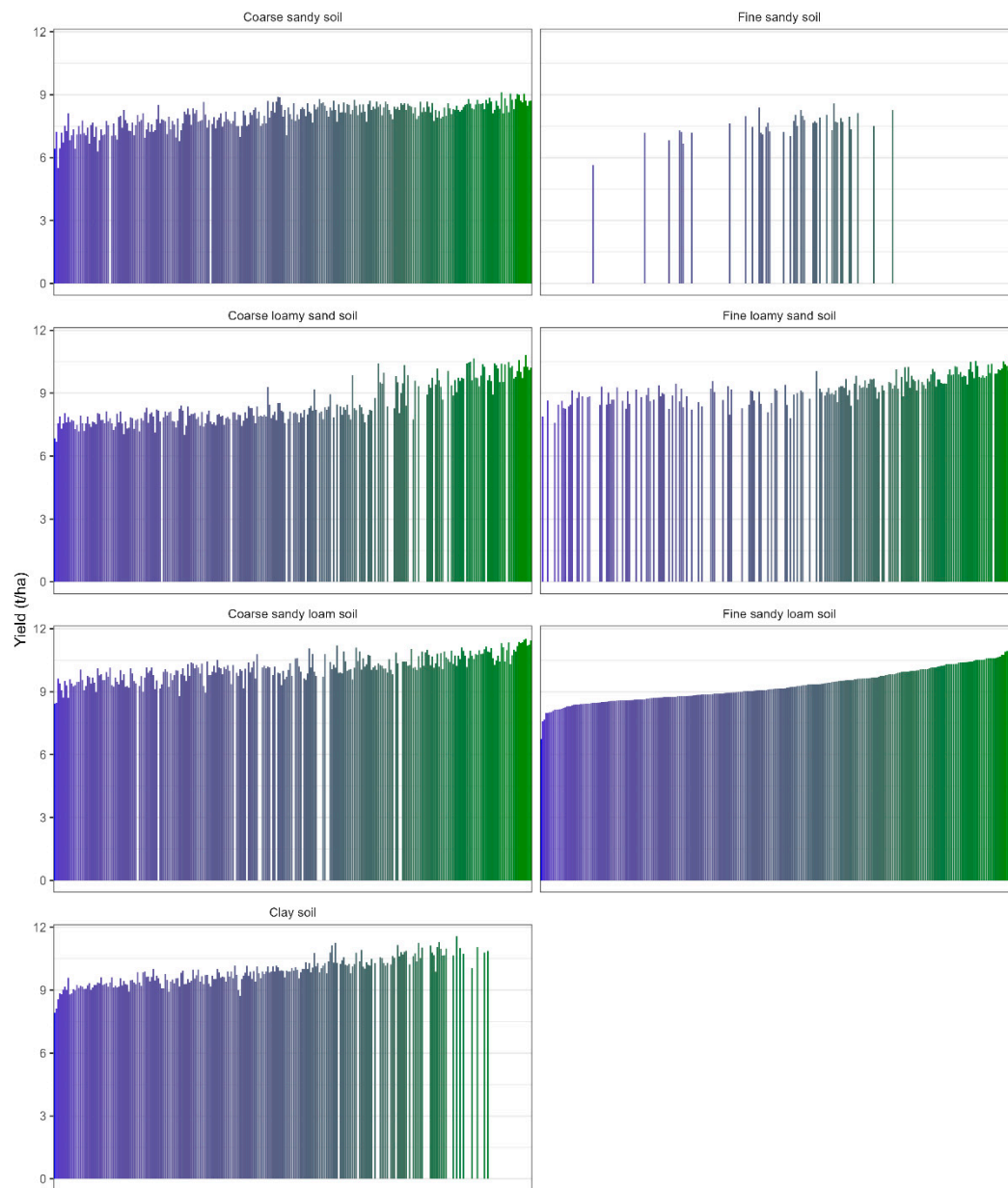


Figure S4: Estimated variety-specific yield of the 276 winter wheat varieties by soil type based on a linear mixed model. Each bar represents a variety. In all panels, varieties are sorted and colored (from blue lowest to green highest) by yield performance in fine sandy loam soil.

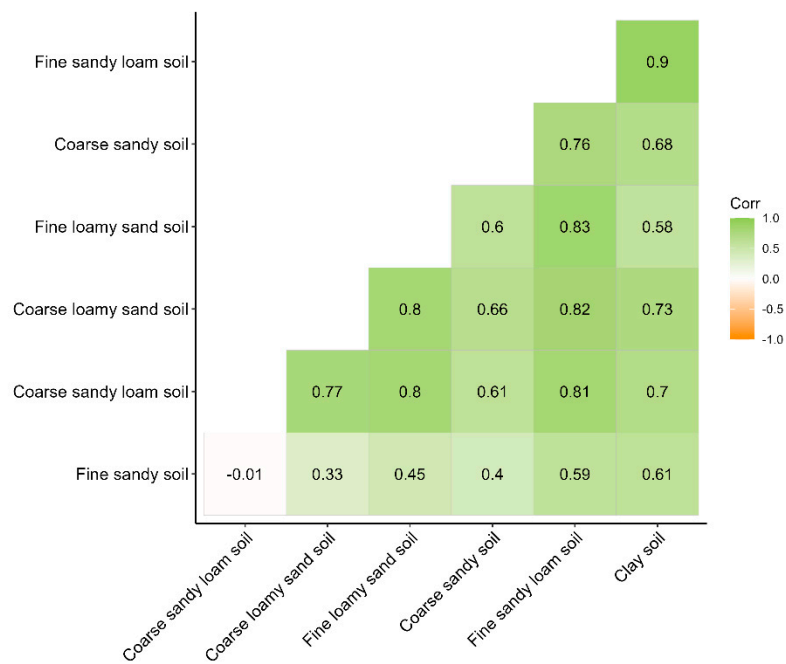


Figure S5: Spearman correlations between estimated variety-specific yields in different soil types.

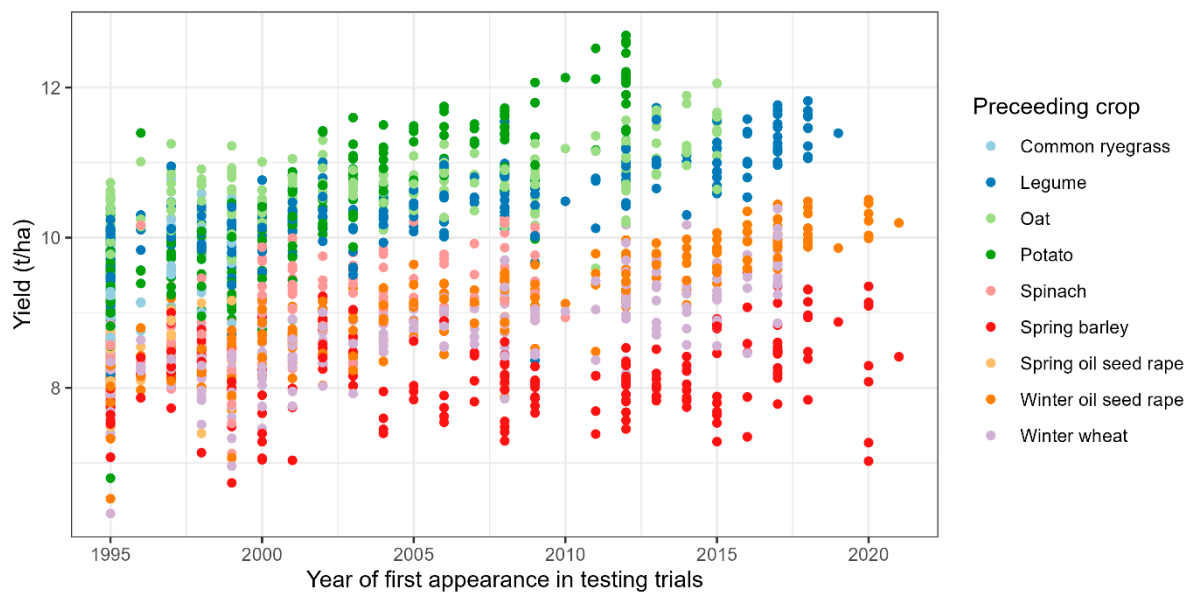


Figure S6: Estimated mean yield for each of the 276 varieties included in the robust data set by preceding crop and year of first appearance in the testing trials. Estimates were based on a linear mixed model.

Table S1. The Danish Soil Classification System.

Soil type	Texture classification	% Clay (< 0.002 mm)	% Silt: (0.002-0.02 mm)	% Fine sand (0.02-0.2 mm)	% Sand (0.02-2 mm)	% Humus
1	Coarse sandy soil	0-5	0-20	0-50	75-100	<10
2	Fine sandy soil	0-5	0-20	50-100	75-100	<10
3	Coarse loamy sand soil	5-10	0-25	0-40	65-95	<10
4	Fine loamy sand soil	5-10	0-25	40-95	65-95	<10
5	Coarse sandy loam soil	10-15	0-30	0-40	55-90	<10
6	Fine sandy loam soil	10-15	0-30	40-90	55-90	<10
7	Clay soil	15-25	0-35		40-85	<10

The Danish Soil Classification System encompasses an area of 34,519 km² (Department of Agroecology, Aarhus University, Den Danske Jordklassificering (au.dk)). It comprises approximately 320 soil classification maps, each at a scale of 1:50,000. These maps provide information regarding soil texture, landscape slope, natural drainage patterns, and the geological origin of the soil down to a depth of roughly 1 meter. The determination of soil texture composition is based on a dataset of around 36,000 soil samples obtained from the 0 to 20 cm soil layer covering the entire country. These 36,000 samples have been classified into the seven distinct soil types. To enhance the precision of the 1:50,000 maps, collaborative efforts with local agricultural consultants were undertaken to achieve a finer resolution of 1:200,000, approximately equivalent to a 2 km² resolution.

Table S2: Model output from the three linear mixed models; p-values for the fixed effects and variance components for the random effects.

	Model 1	Model 2	Model 3
Variety	<0.0001	<0.0001	<0.0001
Soil type	<0.0001	<0.0001	<0.0001
Preceding crop		<0.0001	<0.0001
Variety*soil type	<0.0001		<0.0001
Variety*preceding crop			<0.0001
Soil type* preceding crop			<0.0001
Variety*soil type*preceding crop			<0.0001
σ_{year}	5.68	3.17	6.14
$\sigma_{\text{trial*year}}$	9.63	14.60	9.22
$\sigma_{\text{Soil*Variety*year}}$	1.94		
$\sigma_{\text{preCrop*Variety*year}}$		2.15	
$\sigma_{\text{Soil*Variety*preCrop*year}}$			2.23
σ_{ϵ}	4.57	3.89	3.69

The total variation in yield was for Model 1: $\sigma_{\text{total}} = 16.08$, and for Model 2 and 3: $\sigma_{\text{total}} = 16.22$.