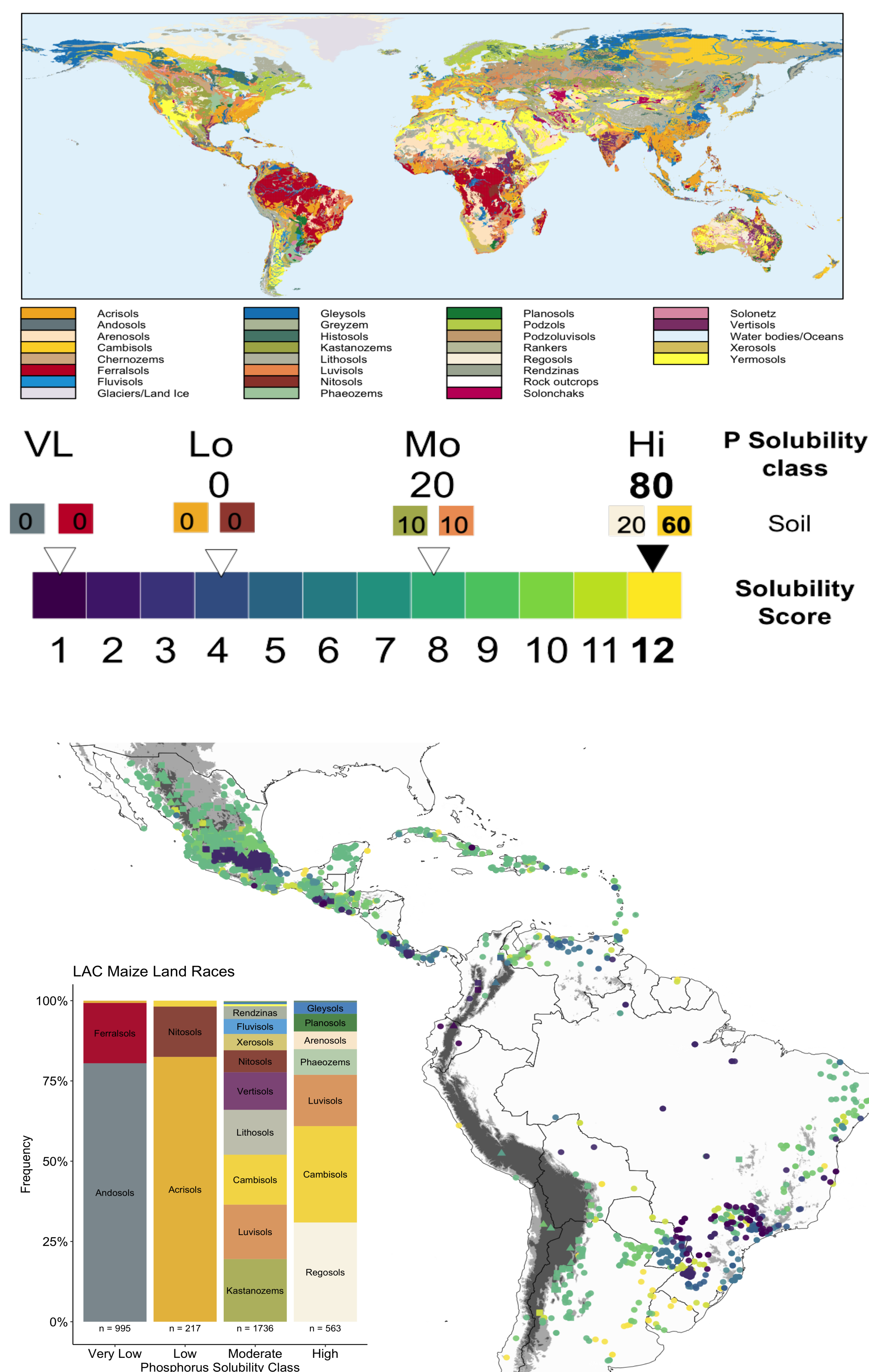


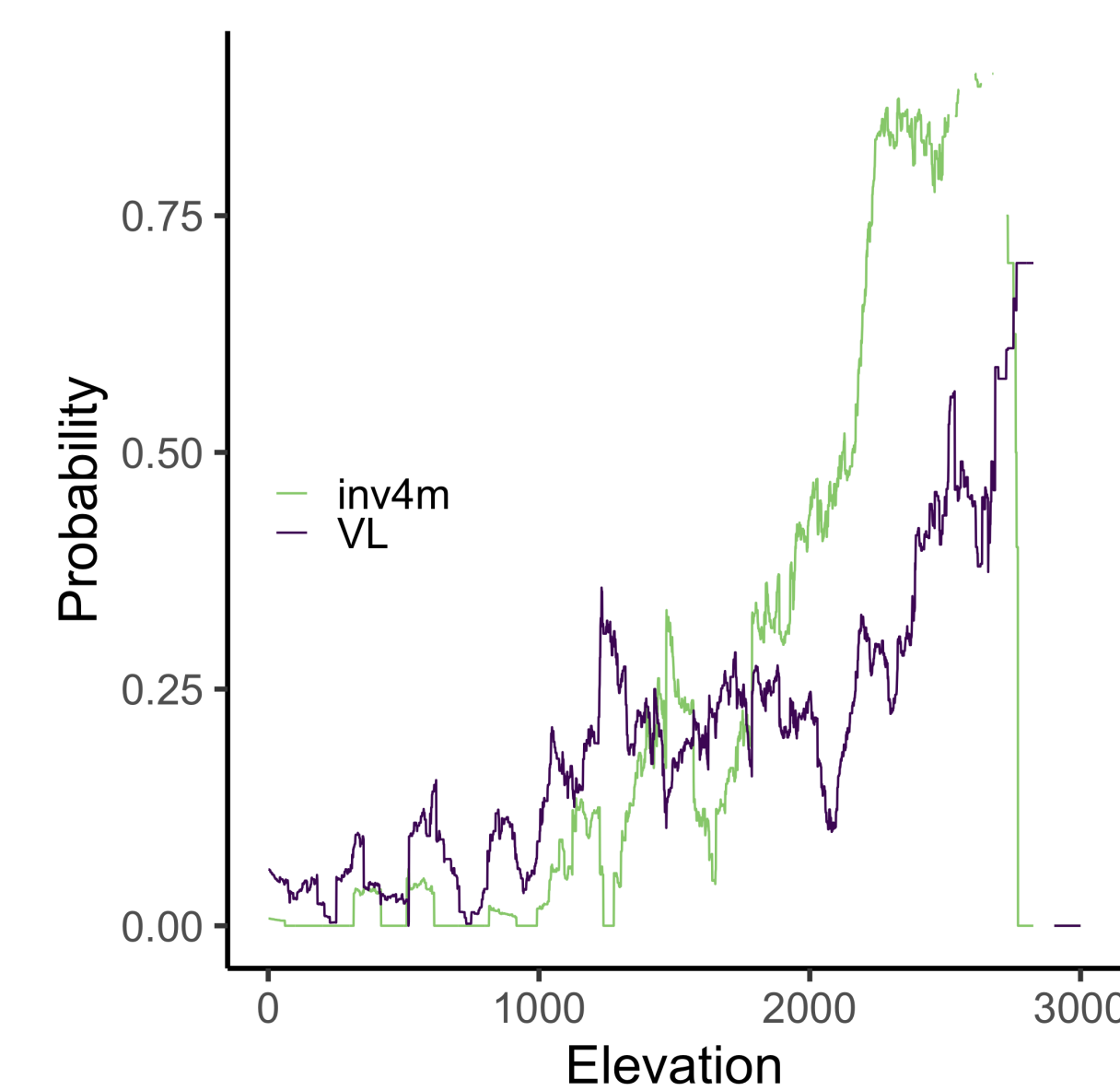
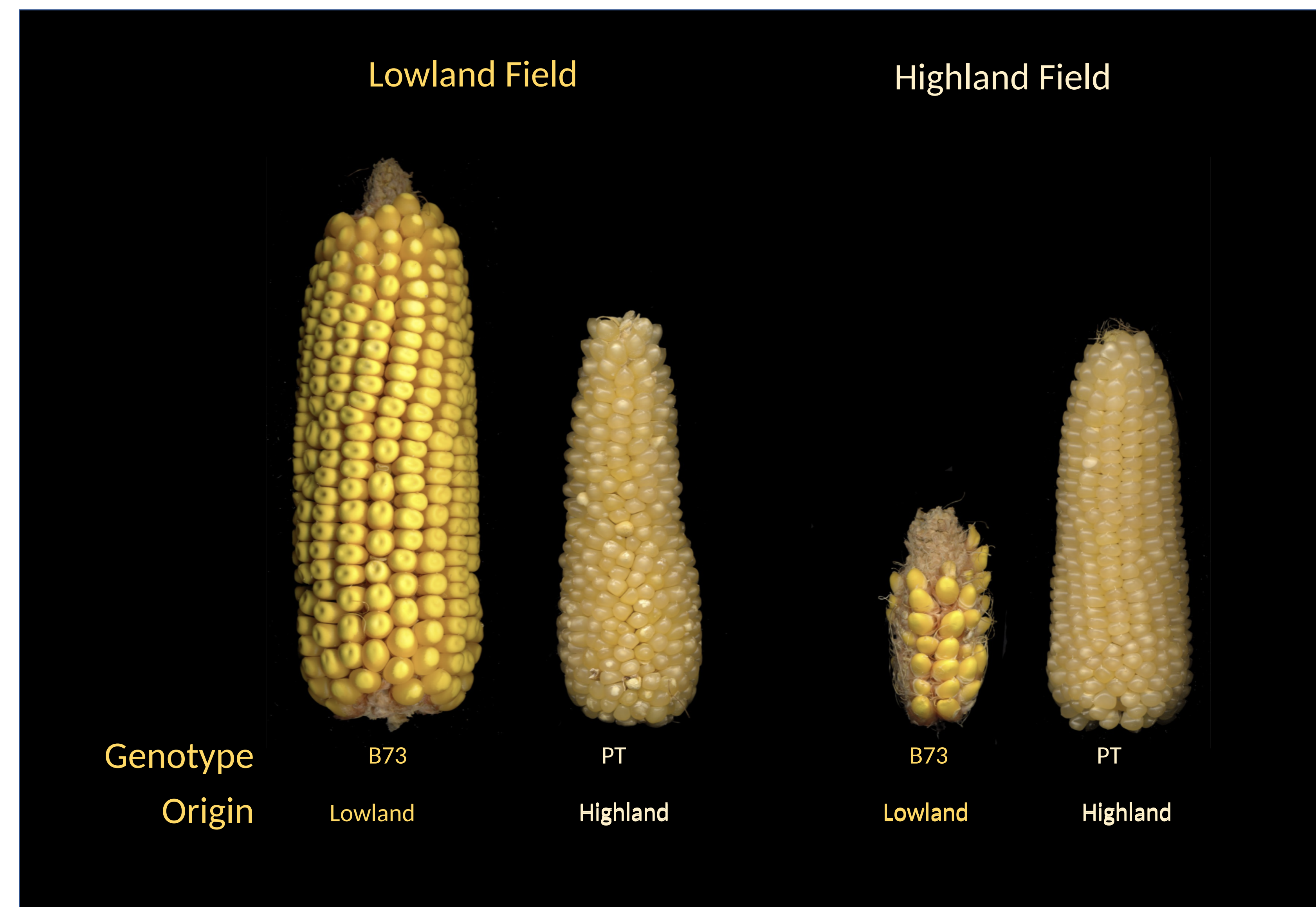
# Genomic Signals of Maize Adaptation to Phosphorus Deficiency

## Phosphorus Availability is Encoded in Soil Maps



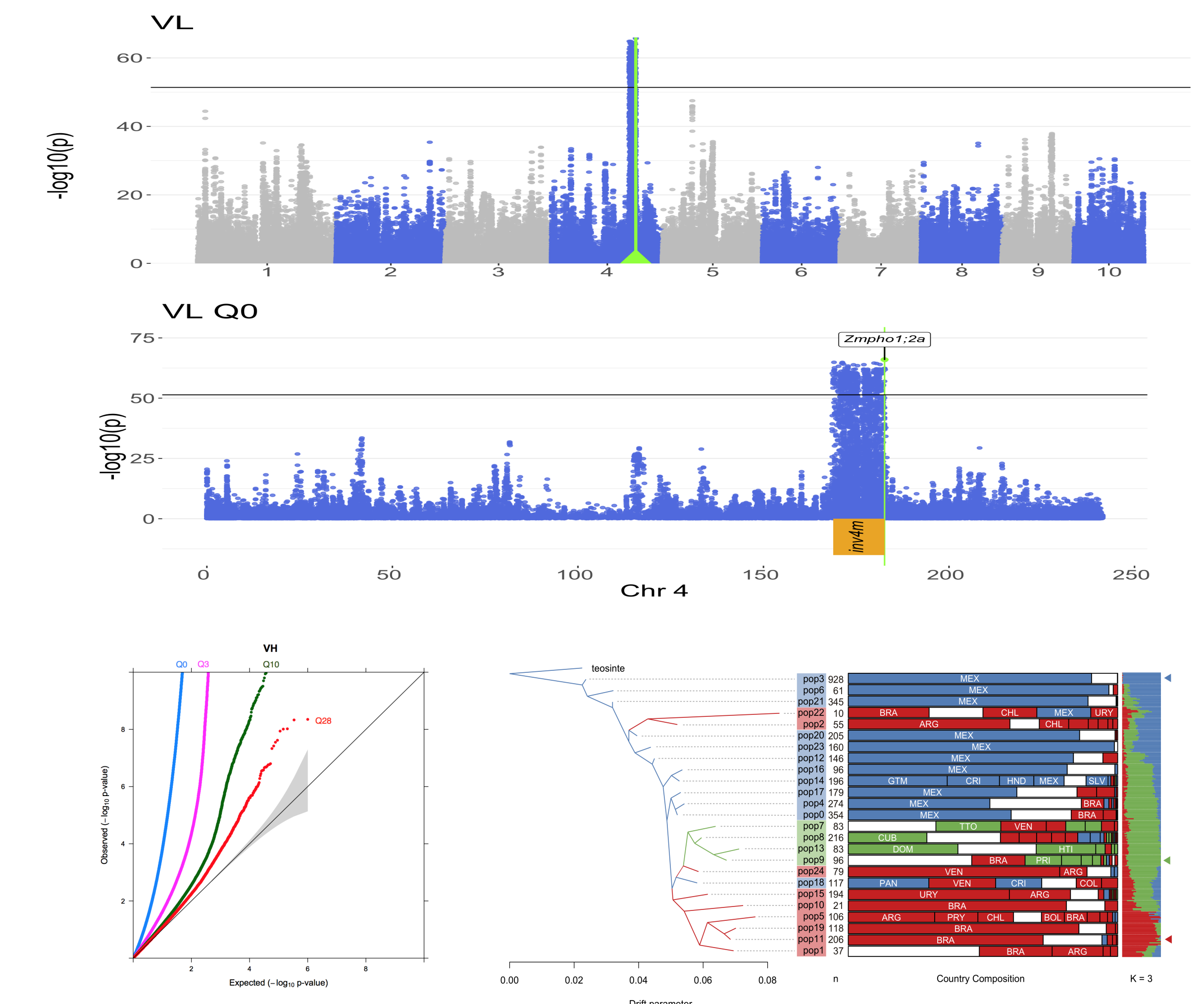
**TOP** FAO74 soil map of the world.  
**MIDDLE** Assignment of Pi solubility class and solubility score (1 low - 12 high) to each soil pixel following Bajés, 2011.  
**BOTTOM** Pi solubility score map for 2743 georeferenced maize accessions from Romero-Navarro et al. 2017.  
**INLAY** Soil class distribution in sampled maize. The Very Low soil Pi is represented mostly by andosols.

## Is Phosphorus Metabolism Contributing to Highland Adaptation?

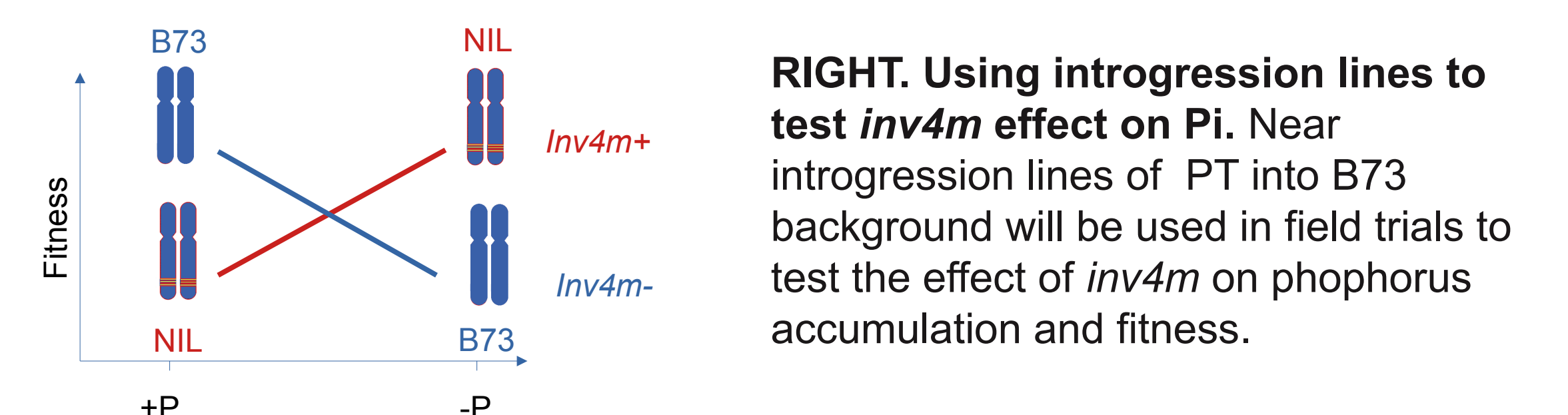


**TOP** Reciprocal transplant under Pi sufficiency, temperate inbred B73 is adapted to lowlands (Puerto Vallarta, MX), Palomero Toluqueño (PT) landrace is adapted to highlands (Metepéc, MX).  
**BOTTOMLEFT** Elevation is correlated to both low Pi and to *inv4m* frequency. Very Low (VL) phosphorus soil probability and *inv4m* frequency calculated on a moving average (window width = 300m).  
**BOTTOMRIGHT** Mass spectrometry Leaf 31P content at highland. In addition to higher yield, PT shows higher phosphorus accumulation (PPB) than B73 at this elevation.

## Soil Phosphorus is Associated to *Inv4m* an Adaptive Introgression from Highland Teosinte.



**TOP** GWAS for VL Probability, threshold line shows upper 1000<sup>th</sup> quantile of ~600k SNPs. Strongest signal comes from Chr4. GLM model on unrelated individuals unadjusted for population structure.  
**MIDDLE** Chr4 detail. Signal comes from the *inv4m* inversion that includes *ZmPHO1;2a* a xylem Pi transporter. *Inv4m* has been proposed to be an adaptive introgression from highland teosinte (*Zea mays spp mexicana*)  
**BOTTOM LEFT** GWAS Q-Q-PLOT, of ancestry matrix calculated with ADMIXTURE, for 0 to 28 subpopulations. Some signal from *inv4m* is recovered even from Q28.  
**BOTTOM RIGHT** POPULATION STRUCTURE. For K = 25, drift tree nodes, and K = 3, country barplot, ancestry barplot.



**RIGHT** Using introgression lines to test *inv4m* effect on Pi. Near introgression lines of PT into B73 background will be used in field trials to test the effect of *inv4m* on phosphorus accumulation and fitness.

## References

Romero Navarro, J., Willcox, M., Burgueño, J. et al. A study of allelic diversity underlying flowering-time adaptation in maize landraces. Nat Genet 49, 476–480 (2017).  
N. H. Batjes. Global distribution of soil phosphorus retention potential. Technical report, ISRIC-World Soil Information, Wageningen, (2011).