

# Location, location, location: Identifying precise, repeatable, and representative real estate for barley uniform nurseries



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## Takeaways

- Not all locations in uniform nurseries are ideal for phenotyping all traits
- We developed an optimization method to select the best locations for phenotyping
- Compared to all locations, optimization maintained or increased phenotype data quality while reducing costs

## Introduction

Breeding programs test multi-trait genotype performance in costly multi-location trials

Test locations can be evaluated using three criteria<sup>1</sup>:

- Precision:** the power to discriminate genotypes
- Repeatability:** the consistency of genotype performance
- Representativeness:** the similarity of a location to a mega-environment

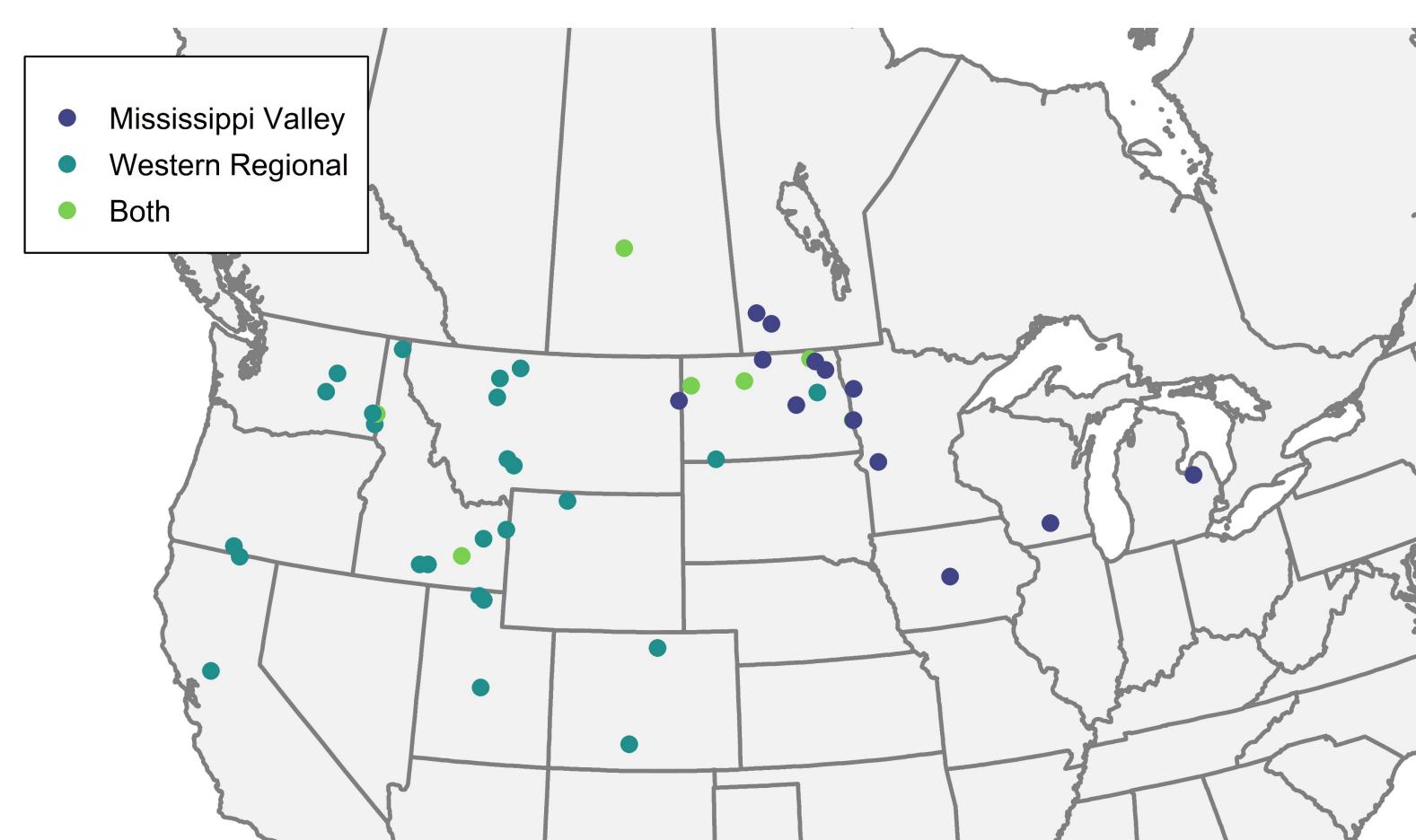
Can we improve the efficiency of regional nurseries by determining the best locations for phenotyping?

### Objectives:

- Compare test location precision, repeatability, and representativeness in two regional barley nurseries
- Determine optimized test locations for phenotyping multiple agronomic and malting quality traits

## Materials and Methods

We used data from the Mississippi Valley (MVN) and Western Regional (WRN) uniform nurseries



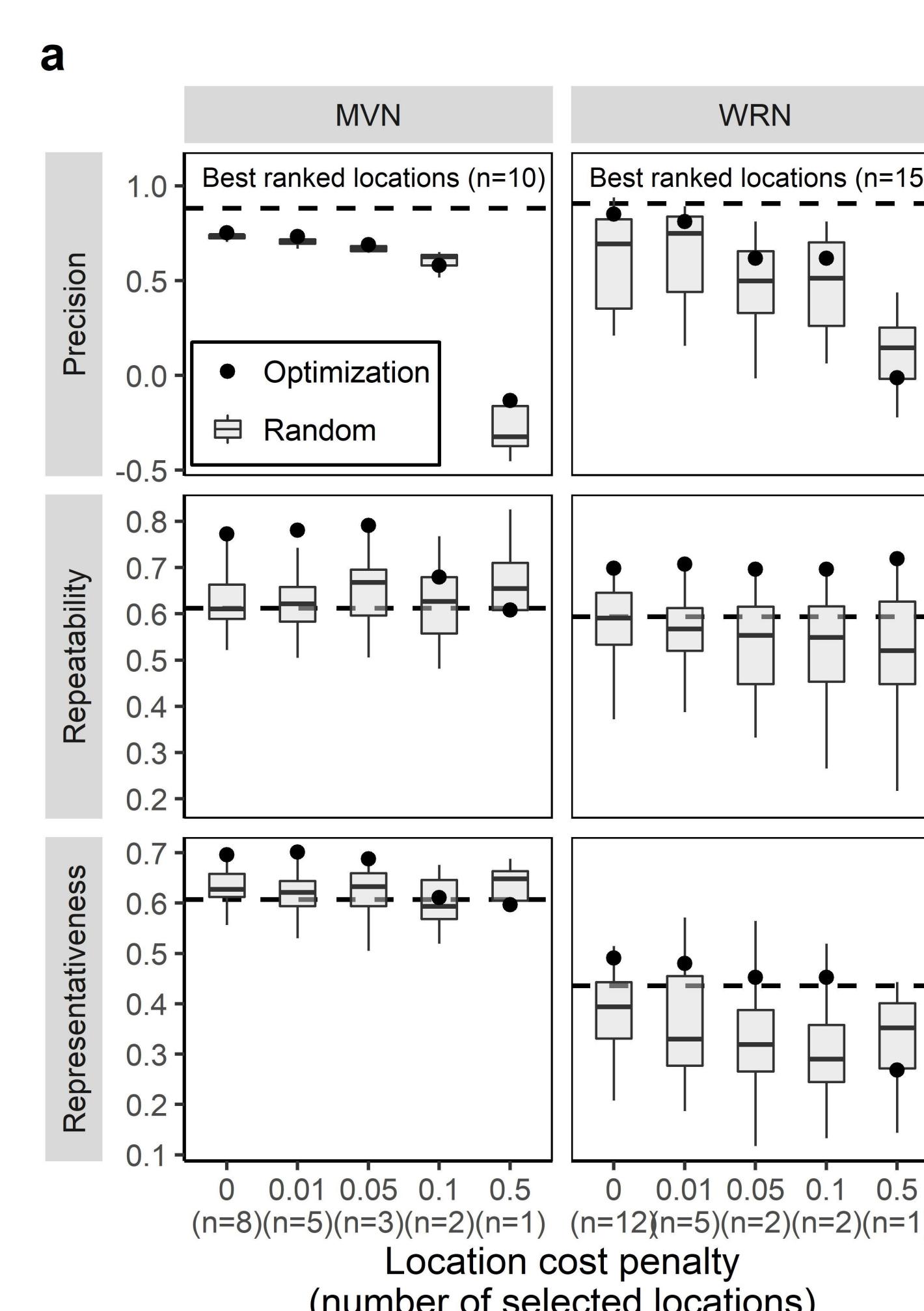
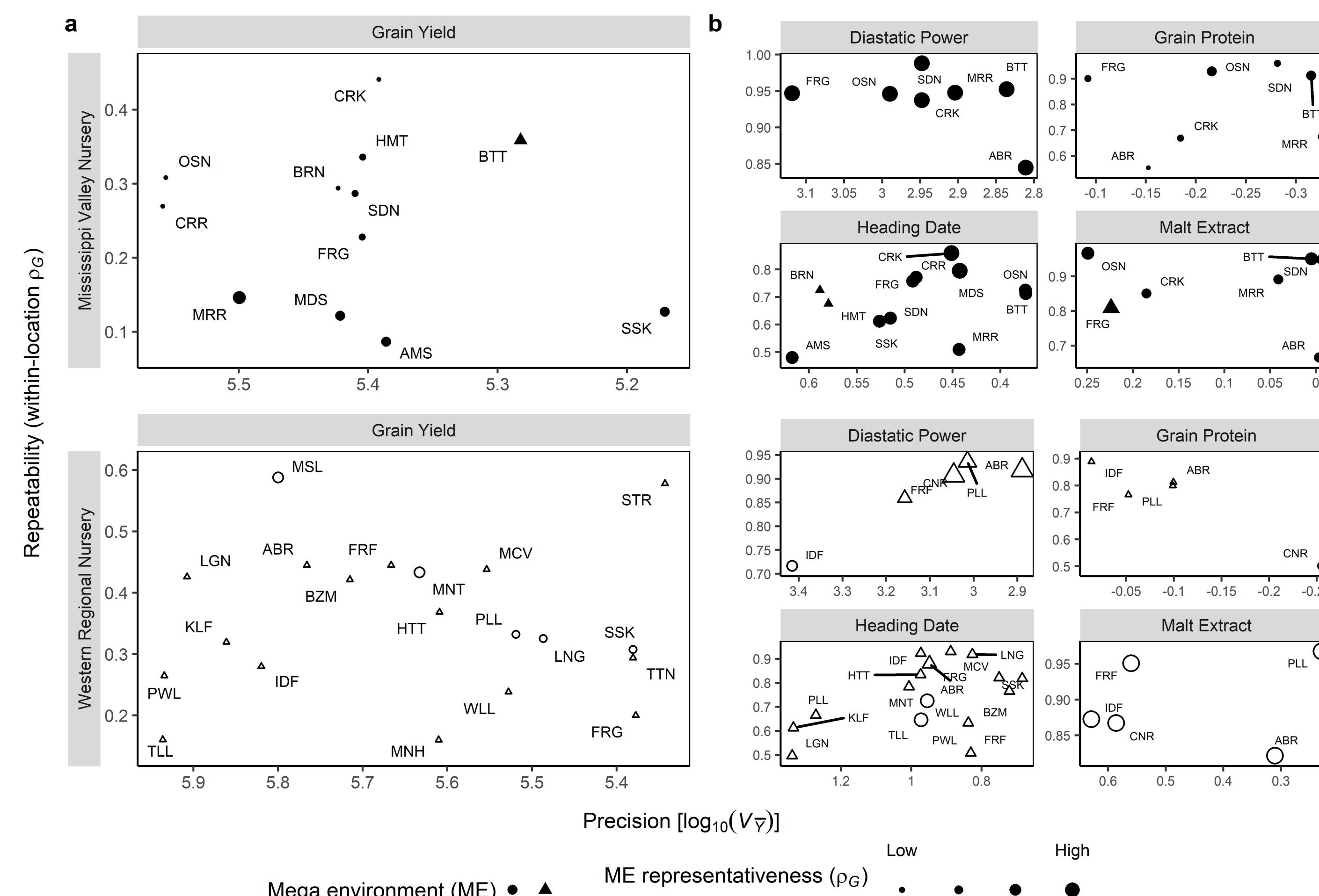
Parameter	MVN	WRN
Locations	20	32
Years	25	23
Environments (Location-Year)	175	251
Genotypes	401	393
Traits	19	18

Three statistics were estimated per location:

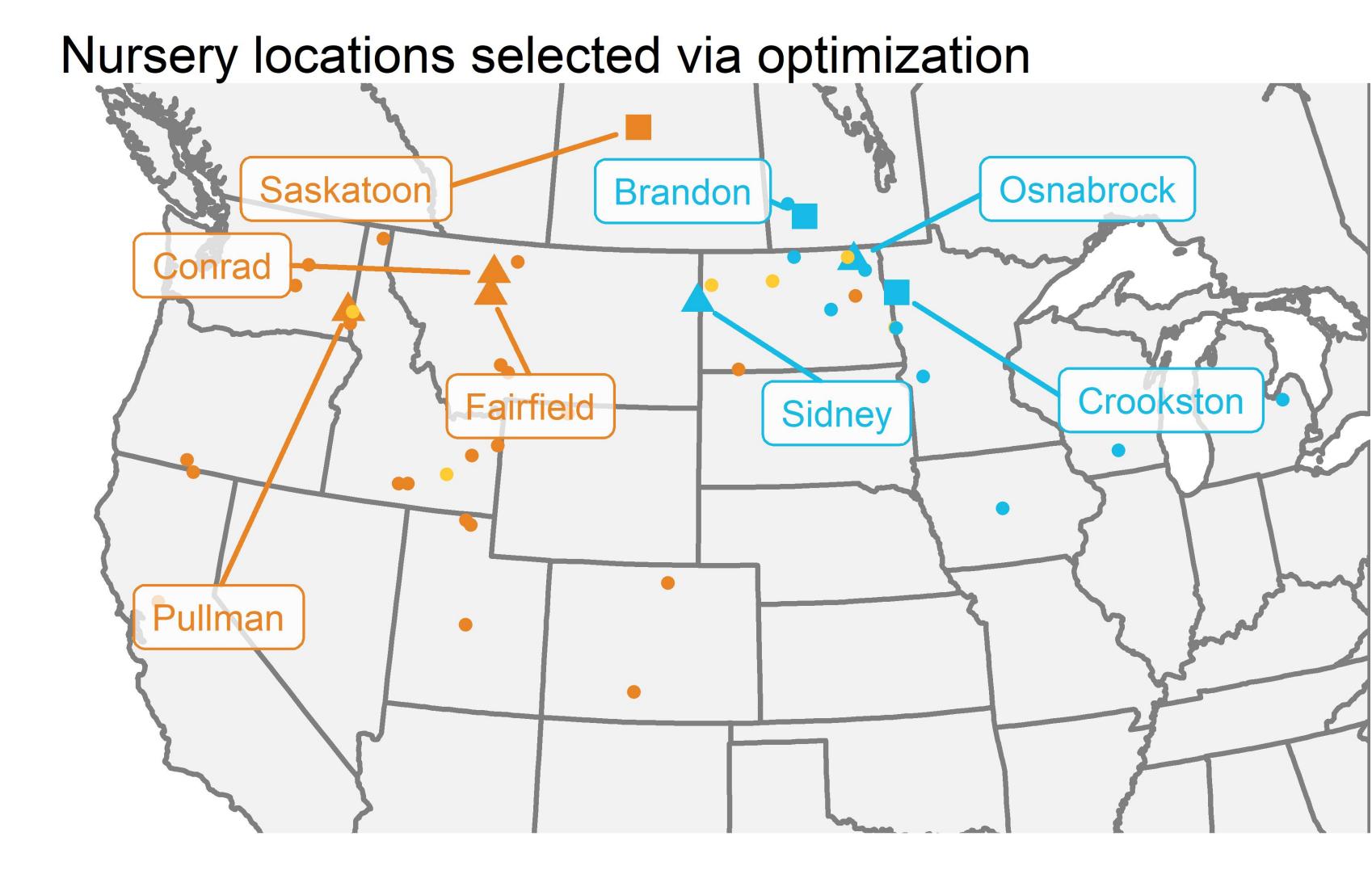
- Precision** - variance of a genotype mean ( $V_{\bar{Y}}$ ) (lower  $V_{\bar{Y}}$  means more precise)<sup>2</sup>
- Repeatability** - genetic correlation ( $\rho_G$ ) across years (higher  $\rho_G$  means more repeatable)
- Representativeness** -  $\rho_G$  between a location and a mega-environment (higher  $\rho_G$  means more representative)

We defined an optimization algorithm to select locations that maximized these statistics for multiple traits

## Results



Fewer, optimized locations led to similar or better phenotype data quality compared to all or random sets of locations



Nursery	Selected Agro. Trait Loc.	Selected Malt Qual. Trait Loc.	% Improvement Vs. All Locations		
			Precision	Repeatability	Representativeness
MVN	5	2	-7.48	33.3	15.0
WRN	5	3	2.98	16.0	8.05

Optimization generally increased phenotype data quality while reducing the number of locations by 50-75%

## Read more / reach out



Read our paper in *Crop Science*

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## References

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- [2] Bernardo, R. 2010. *Breeding for Quantitative Traits in Plants*. Stemma Press, Woodbury, Minnesota, 2 edition.