

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 genotypes performance in costly multi-location trials

Test locations can be evaluated using three criteria¹:

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

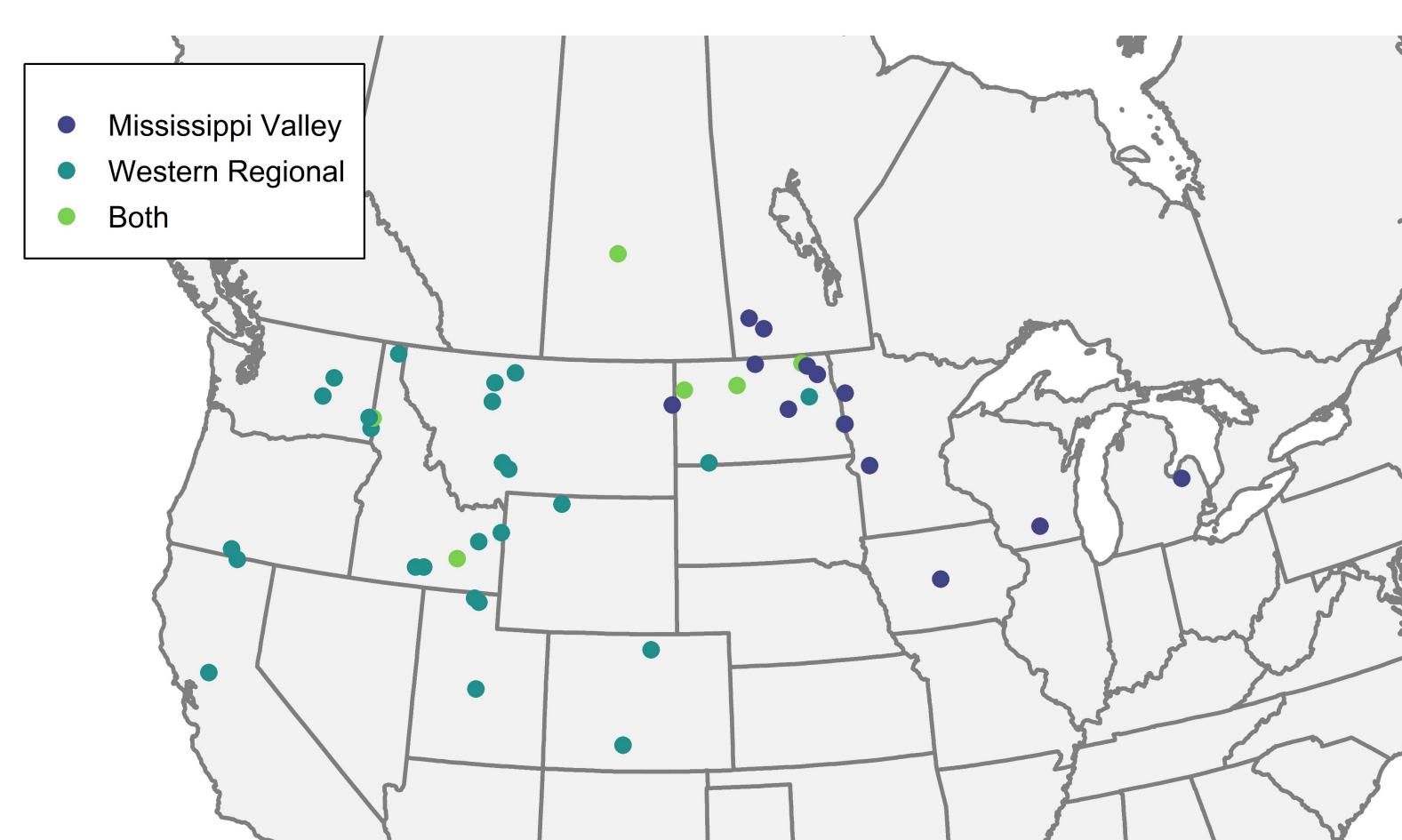
Can we improve the efficiency of regional nurseries by determining the best locations for phenotyping?

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



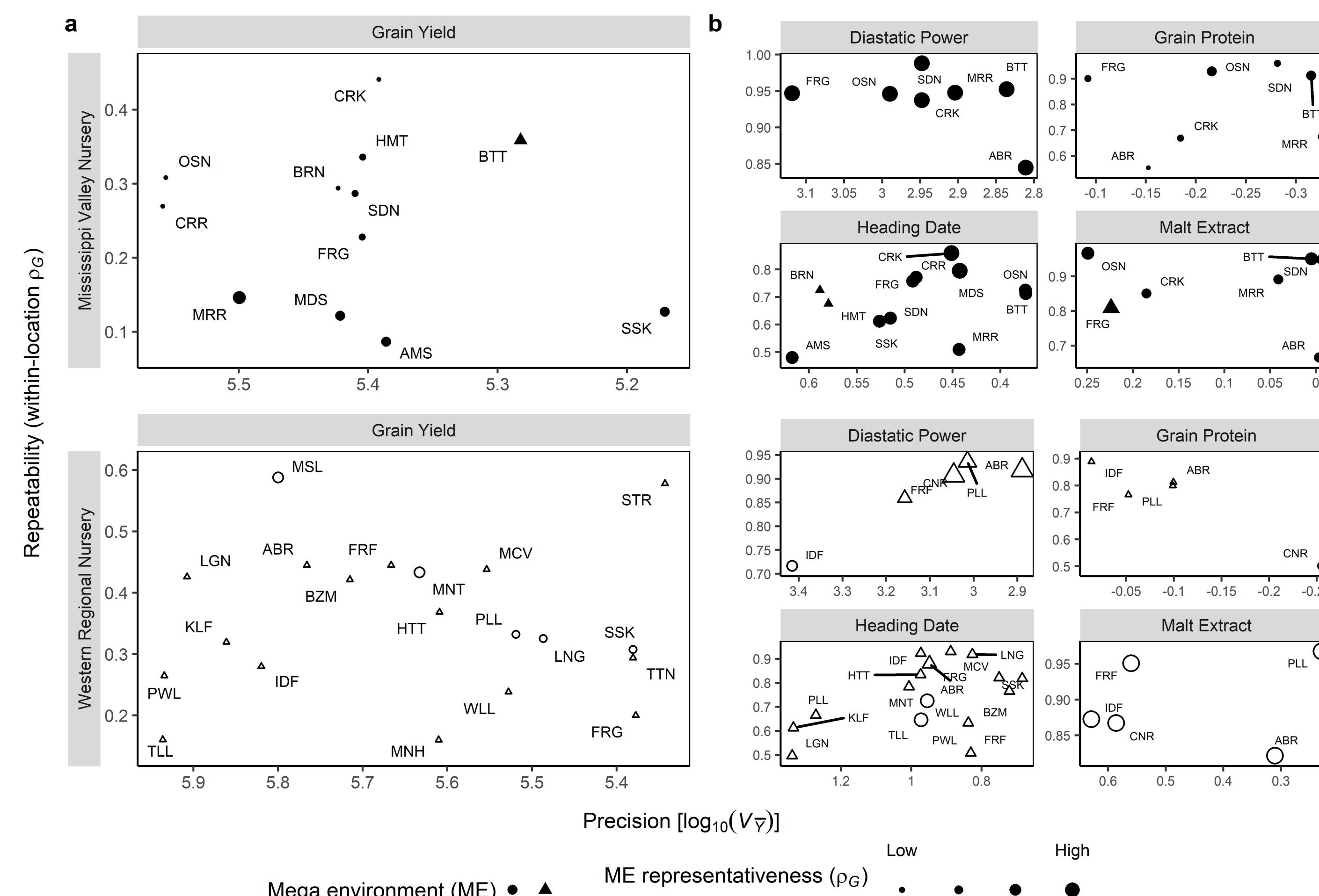
Parameter	MVN	WRN
Locations	20	32
Years	25	23
Environments (Loc.-Yr.)	175	251
Genotypes	401	393
Traits	19	18

Three statistics were estimated per location:

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

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

Results

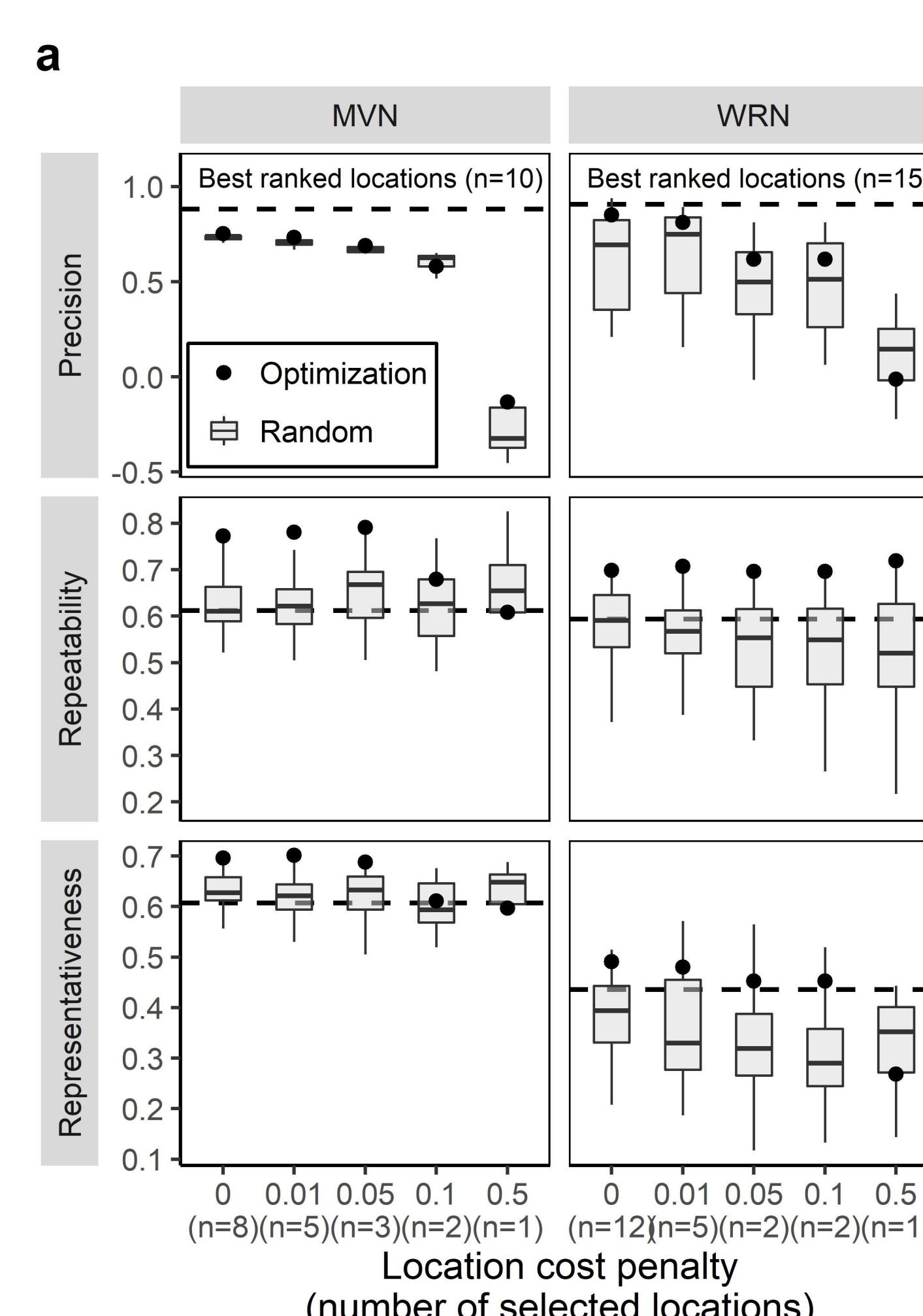


The best test locations are denoted by larger points in the upper-right corner of each plot

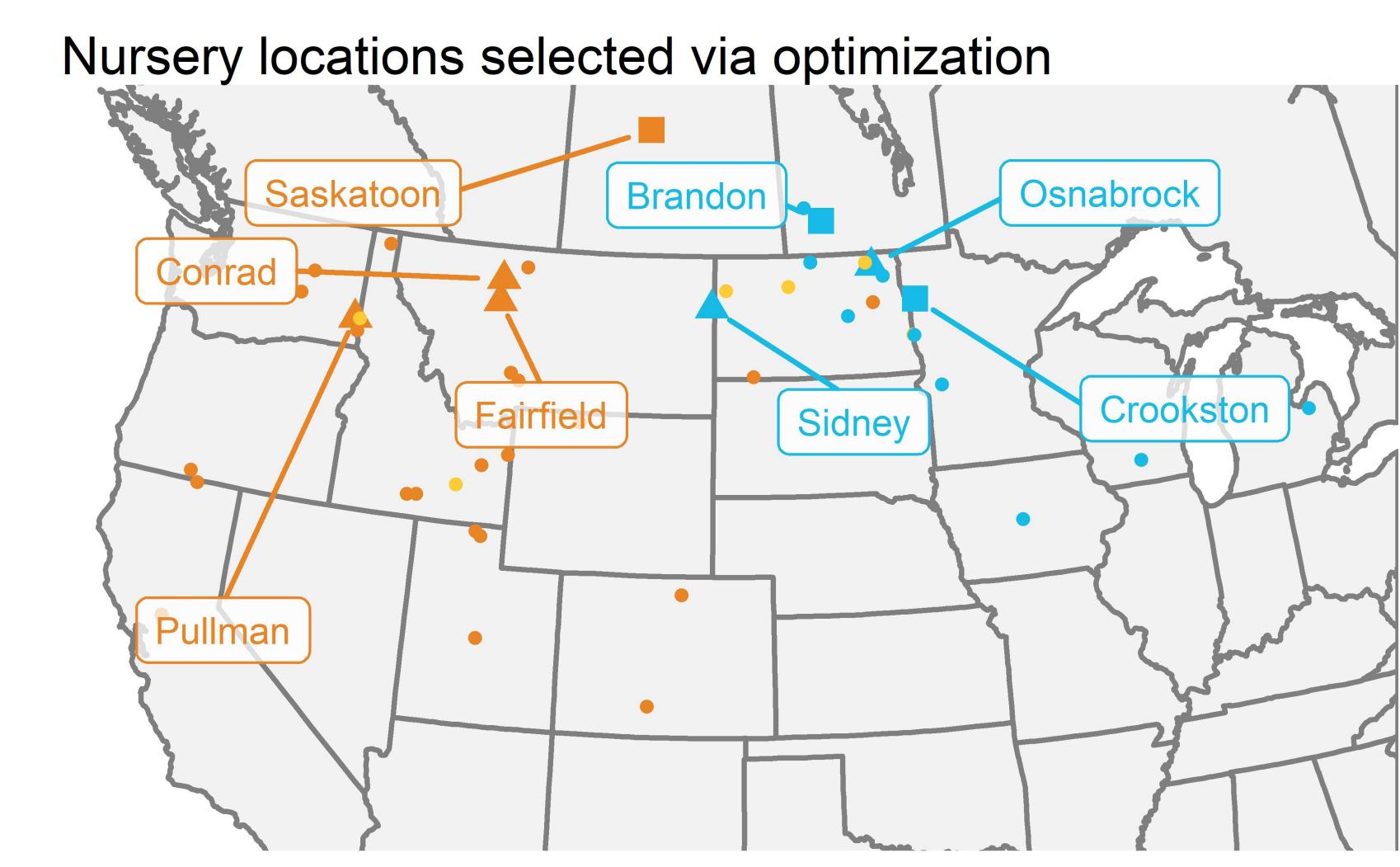
Some locations are ideal for multiple traits: BTT (Bottineau, ND); PLL (Pullman, WA)

For other locations, only some traits are reliably phenotyped: MRR (Morris, MN); ABR (Aberdeen, ID)

Most test locations are not ideal for phenotyping all traits



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.