Integration of innovative plant phenotyping tools in spring wheat breeding in Latvia

Zaiga Jansone, Māra Bleidere, Andris Lapāns, Valentīna Fetere

Institute of Agricultural Resources and Economics

Introduction

The greatest challenge in any crop breeding research in the 21st century is the ability to predict yield that is as close as possible to the genetic potential of a new variety. The use of High-Throughput plant phenotyping (HTPP) tools in wheat breeding programme has a potential to identify superior genotypes quickly and efficiently.

Research Objective

The aim of research is to evaluate the dispersion of spectral reflectance indices for spring wheat genotypes in the different stages of plant development to find out the correlative relationships with grain yield.

Materials and methods

- Field trials with 300 spring wheat (*Triticum aestivum* L.) genotypes were established at the AREI Stende Research Centre in 2021 and 2022. Plot size 5 m² in 2 replications.
- Traits phenotyped by breeder: plant phenology, plant height, grain yield, grain quality attributes.
- Two digital phenotyping platforms were used to obtain wheat plant canopy spectral images: (1) unmanned aerial vehicle (UAV) Phantom 4Pro with a multi-spectral camera (20 m height), ones a week from plant emergence to maturity; (2) **ground-based vehicle (GBV)** with RGB Canon EOS 1300D camera (2 m height) in three plant growing stages - tillering begins (GS 21), flowering halfway (GS65) and early milk (GS73).

Results & Discussion

Multispectral indices		HTPP	Equition/Description	Function
NDVI	Red normalized difference Vegetation index	UAV	(NIR-RED)/(NIR+RED)	*N content, biomass*
GA	Green area	GBV	Yellow to bluish-green color values	*Green biomass*
GGA	Greener area	GBV	Excluding the yellowish-green color values	*The active photosyntetic area*
CSI	Crop Senescence index	GBV	(GA − GGA)/GA × 100	*Plant senescence*

Grain yield (g kg⁻¹) and vegetation indices variation in GS73 growth stage, n=300, 2021; 2022

Trait	Year	Average	Min	Max	P
Grain yield	2021	503.73	249.48	689.79	<0.001
	2022	623.04	324.29	920.15	<0.001
NDVI	2021	0.7562	0.5912	0.8585	<0.001
	2022	0.771	0.5729	0.8752	<0.001
GA	2021	0.3863	0.109	0.7143	<0.001
	2022	0.6683	0.1833	0.9137	<0.001
GGA	2021	0.2345	0.0286	0.5682	<0.001
	2022	0.3653	0.0246	0.8086	<0.001
CSI	2021	41.474	17.354	80.224	<0.001
	2022	47.7225	11.4992	86.5619	<0.001

Correlation between grain yield and vegetation indices at different growth stages, 2021 and 2022
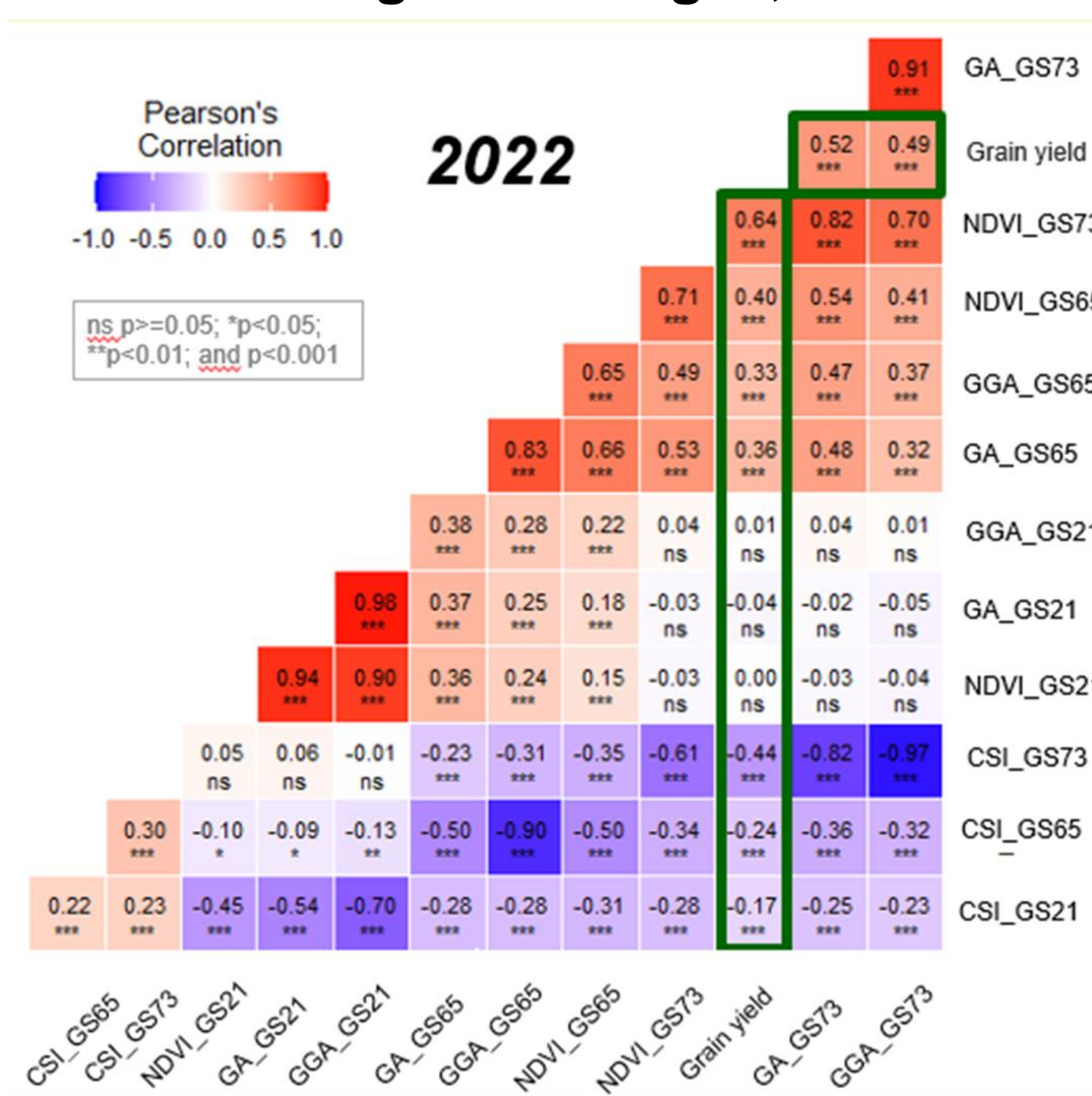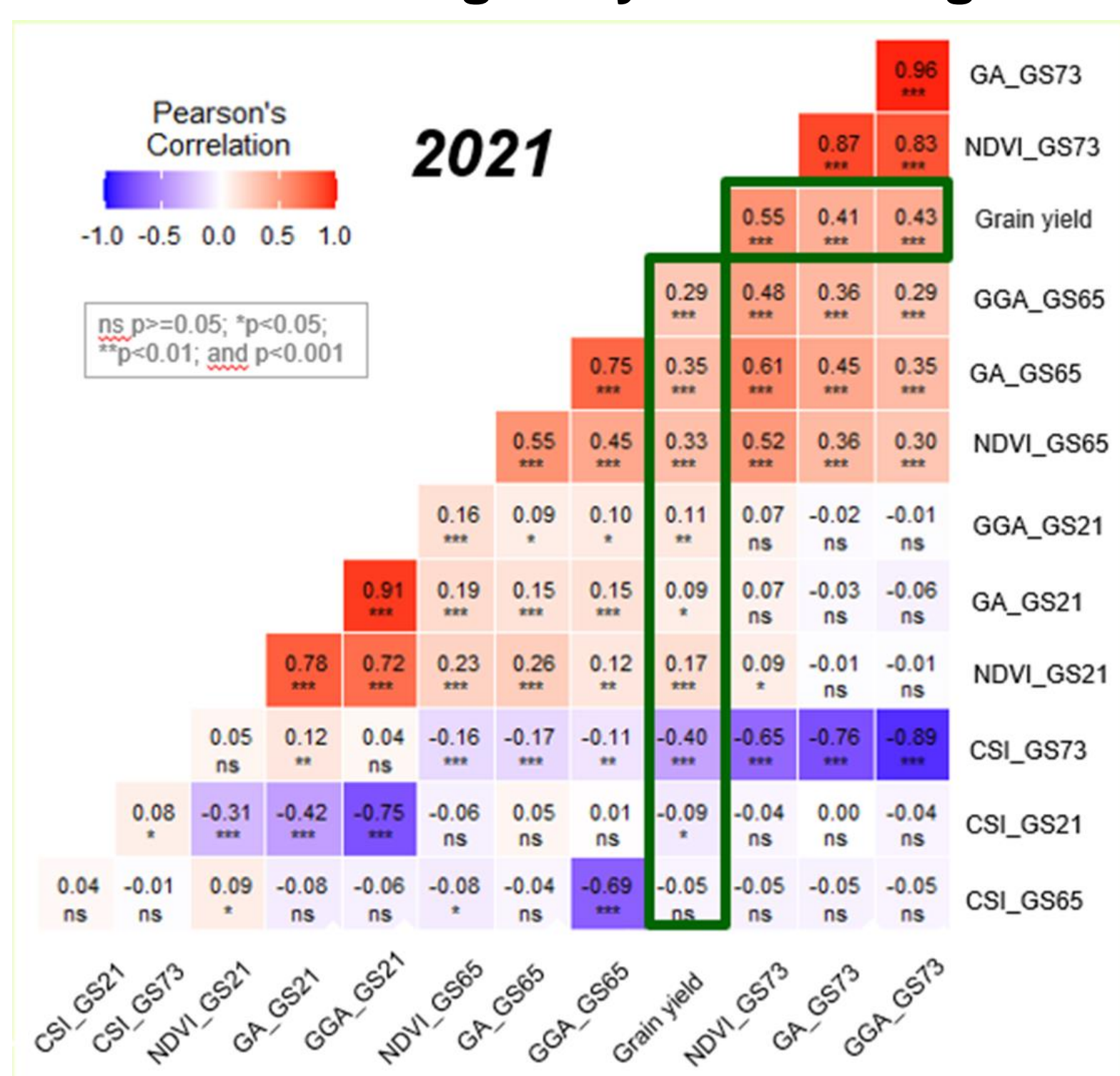
Conclusions

- Statistically significant variation between different genotypes was found for all calculated vegetation indices.
- In this study vegetation indices in the early milk stage determined by both phenotyping tools showed the highest correlation with wheat yield.

Contact Information

"Dizzemes", Dizstende, Libagu parish, Talsu County, LV-3258
zaiga.jansone@arei.lv