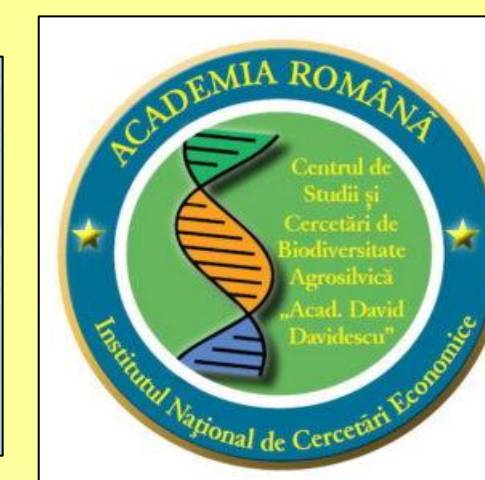




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Keywords: six-row and two-row barley genotypes, environment and genotype interaction, yield stability, quality traits, climate adaptation, multi-location trials.

- ❖ Developing crops with greater adaptability that can sustain steady yield performance represents the fundamental aim of recent plant breeding science and practice (Macholdt and Honermeier, 2016).
- ❖ Romania's barley growing area encompasses 516220 hectares (Eurostat, 2025) producing in average 1.9 million tonnes (between 2015-2025) and a maximum of 3.4 million tonnes in 2025 establishing the country as a significant European barley producer.
- ❖ Conducting trials across multiple environments provides a reliable approach to study genotype-environment interactions while enabling the identification of high-performing genotypes (Hudzenko et. al. 2019). While breeding for yield stability has always been important, it will become even more critical as climate change increases year to year weather variability (Săulescu and Săulescu, 2014).

* This study aimed to evaluate the yield performance and key agronomic traits of 27 barley genotypes (15 winter 6-row genotypes and 12 winter 2-row genotypes) across eight experimental sites in Romania during the 2024-2025 growing season. Each tested variety has been sown at a density of 350 g.s/m² in three replications. The growing technology was a standard one, consisting of minimal soil tillage (harrowing and field cultivation), spring nitrogen fertilisation, and treatments for weed and foliar disease control (1 or 2 applications as needed). The experimental plots (Photo 2) were established in every favourable barley growing condition in Romania (Photo 1), the Romanian Plain (Caracal, Teleorman, Fundulea, Brăila), Dobrogea Plain (Valul lui Traian), Moldavian Steppe (Secuieni), Transylvania Plain (Turda), and West Plain (Livada). The total rainfall (mm) across the experimental locations (Fig 1) during the 2024-2025 barley growing season (October-June) varied from 258 mm (Turda) to 454 mm (Teleorman), representing 196 mm difference between the driest and wettest experimental site. The results were presented as location means and correlations were calculated using R Studio (Version 2024.09.02) for Pearson correlation analysis.

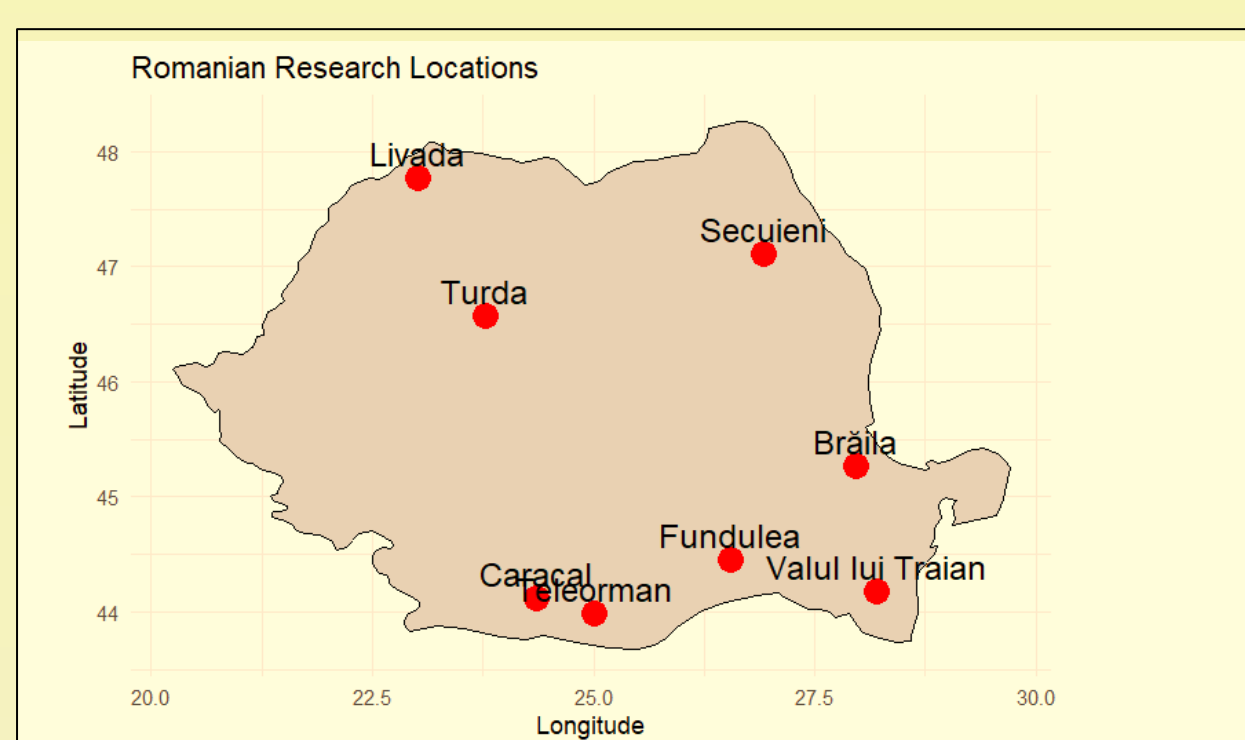


Photo 1. Experimental sites in different pedoclimatic regions of Romania

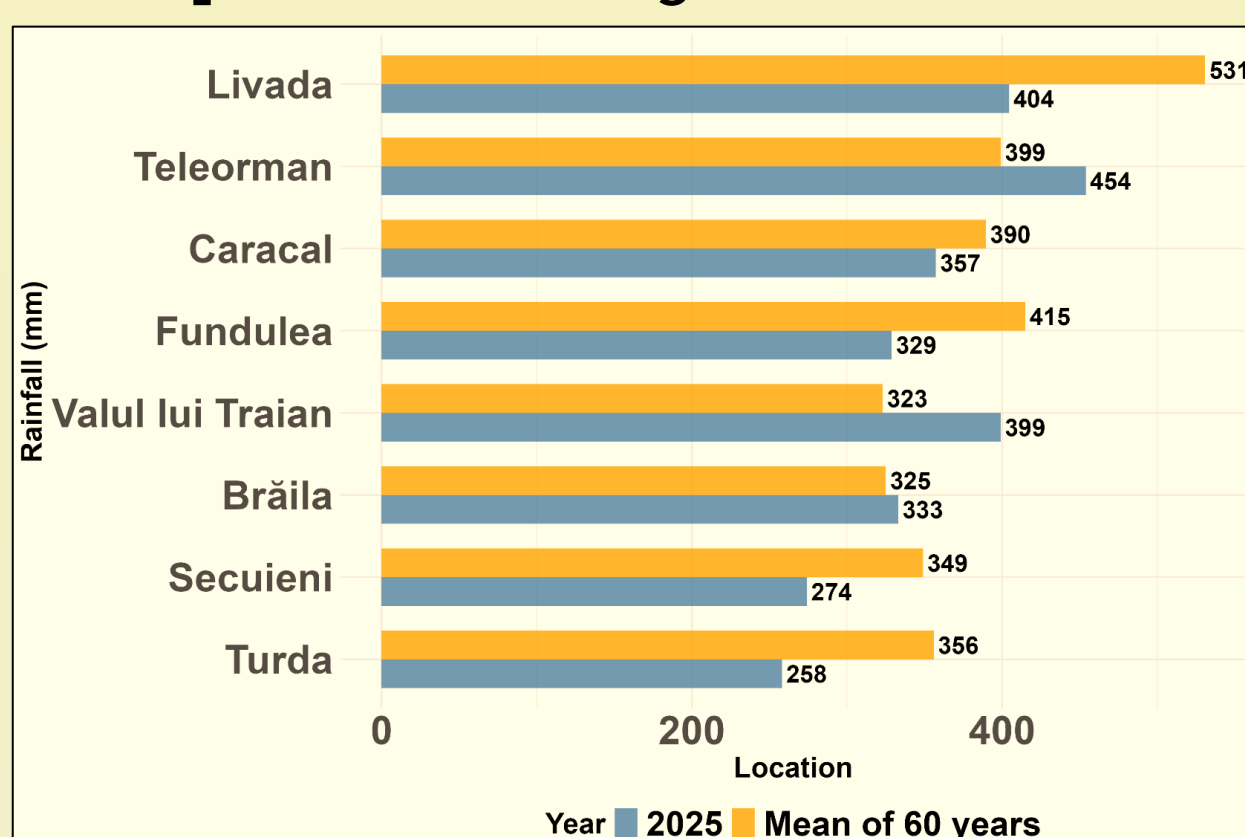


Figure 1. Registered rainfall (mm) during 2024-2025 year



Photo 2. Barley field trials at Fundulea, 2025

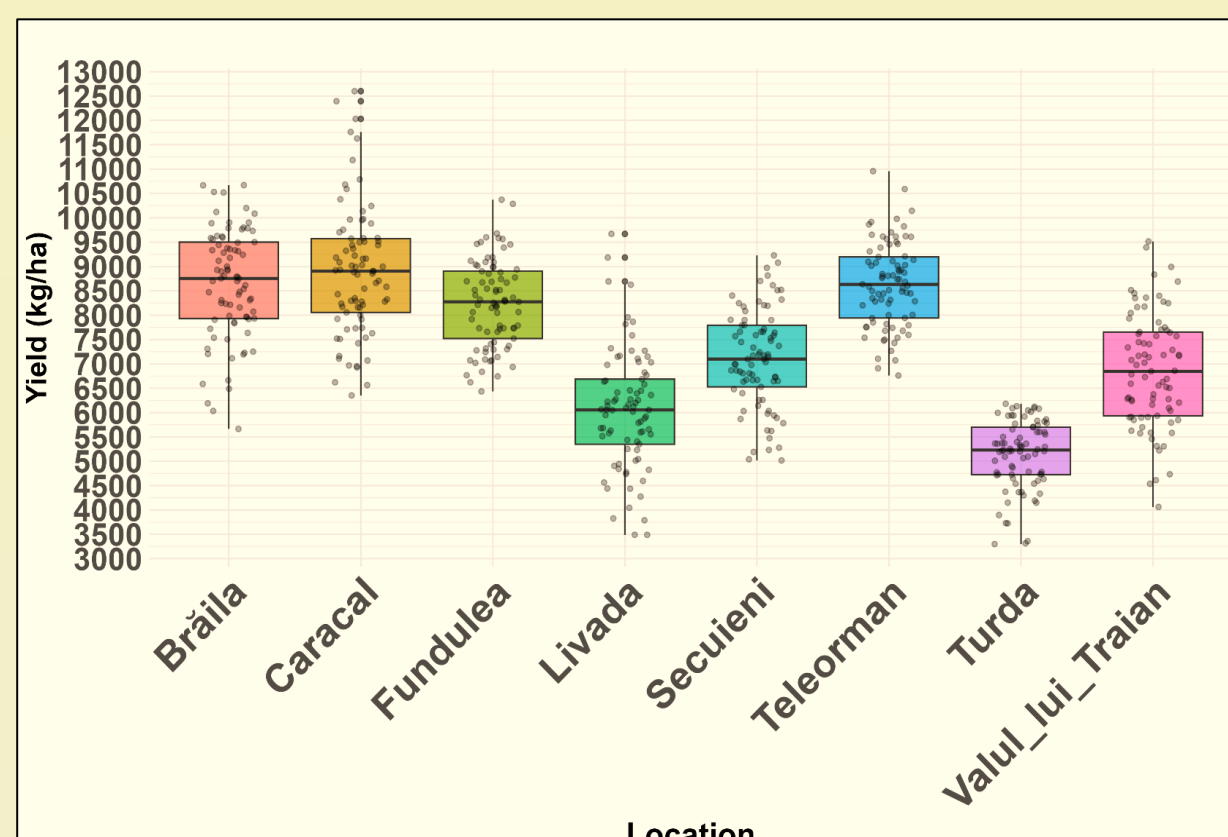


Figure 2. Average yield registered in experimental sites during 2024-2025 year

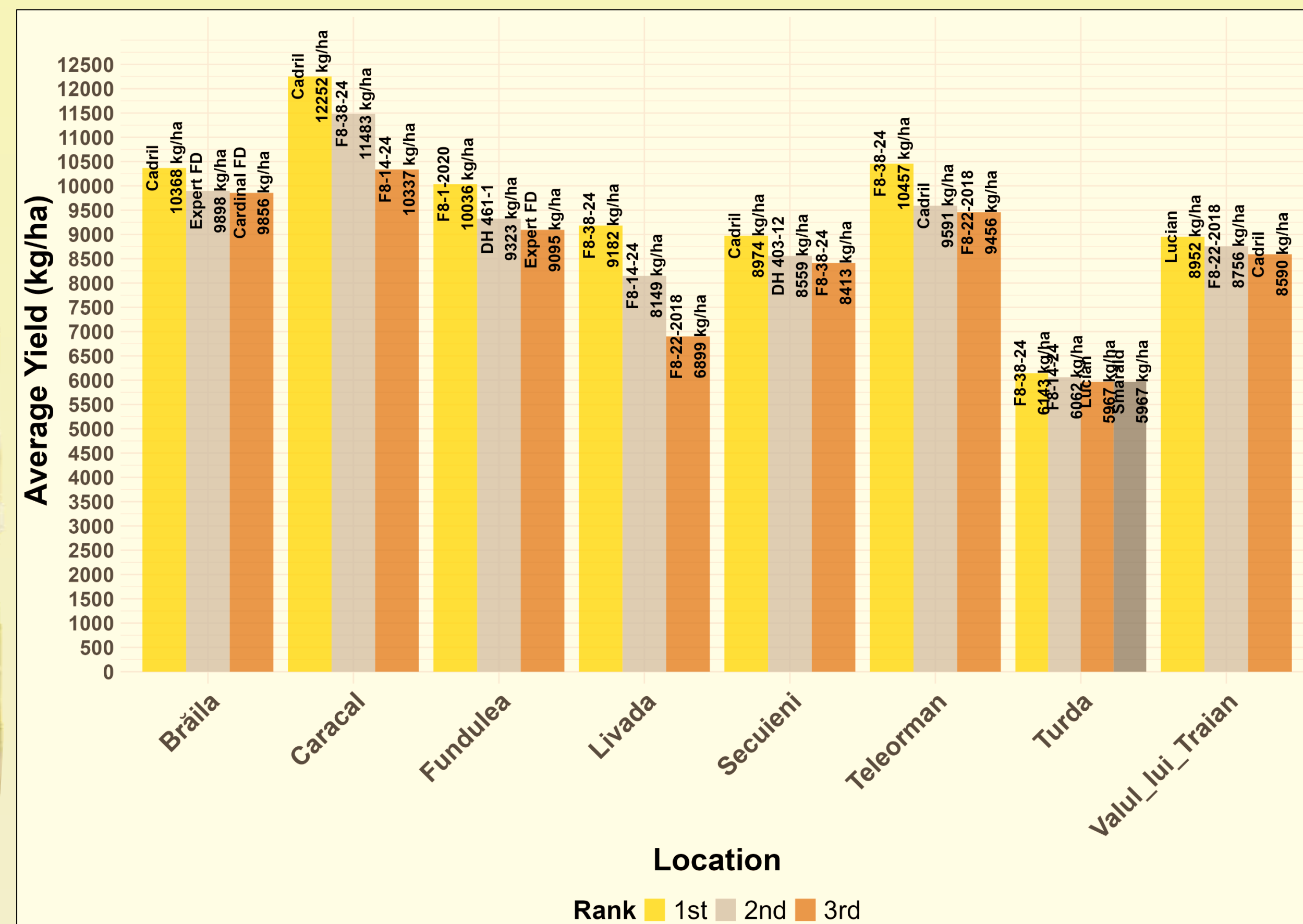


Figure 3. Best performing barley genotypes across eight experimental sites during 2024-2025 year

- ❖ Average yields ranged from 5133 kg/ha at Turda to 8897 kg/ha at Caracal (Figure 2), highlighting environmental effects on yield. Multi-location evaluation revealed significant interaction between genotype and environment and identified high-performing barley varieties across Romanian growing conditions (Figure 3).
- ❖ Caracal was the highest-yielding location with Cadril variety achieving 12252 kg/ha and 10368 kg/ha at Brăila location. A remarkable yield performance was registered by 2-row advanced breeding line F8-38-24 at Teleorman location (10457 kg/ha). Cadril variety demonstrated exceptional stability and high performance, ranking among the top three varieties at five of eight locations (Brăila, Caracal, Secuieni, Teleorman and Valul lui Traian), indicating broad adaptation and consistent yield potential.
- ❖ Correlation analysis between grain yield and quality parameters across eight experimental sites showed that the plant height had the strongest negative correlation with yield ($r = -0.385$, $p < 0.001$), indicating that shorter plants are essential for yield optimization.
- ❖ The strong negative correlation ($r = -0.344$, $p < 0.001$), indicate that high yielding genotypes consistently exhibit lower protein content.
- ❖ Thousand grain weight (g) also negatively correlated with yield ($r = -0.288$, $p < 0.001$), reflecting that as individual grain weight (g) increases (heavier thousand grain weight), overall yield decreases.
- ❖ Grains per spike showed positive correlation with yield ($r = 0.209$, $p < 0.001$), establishing spike fertility as the primary factor for yield enhancement indicating the selection strategy approach for future high yielding barley genotypes.
- ❖ Additionally, starch content increased with yield ($r = 0.142$, $p < 0.001$), indicating that feed quality improves alongside productivity.
- ❖ These relationships were consistent across both 2-row and 6-row barley genotypes, providing an insight of compensatory mechanisms between agronomic traits allowing breeders to exploit beneficial trait combinations to optimize genetic improvement for target markets (food, feed or malting barley).

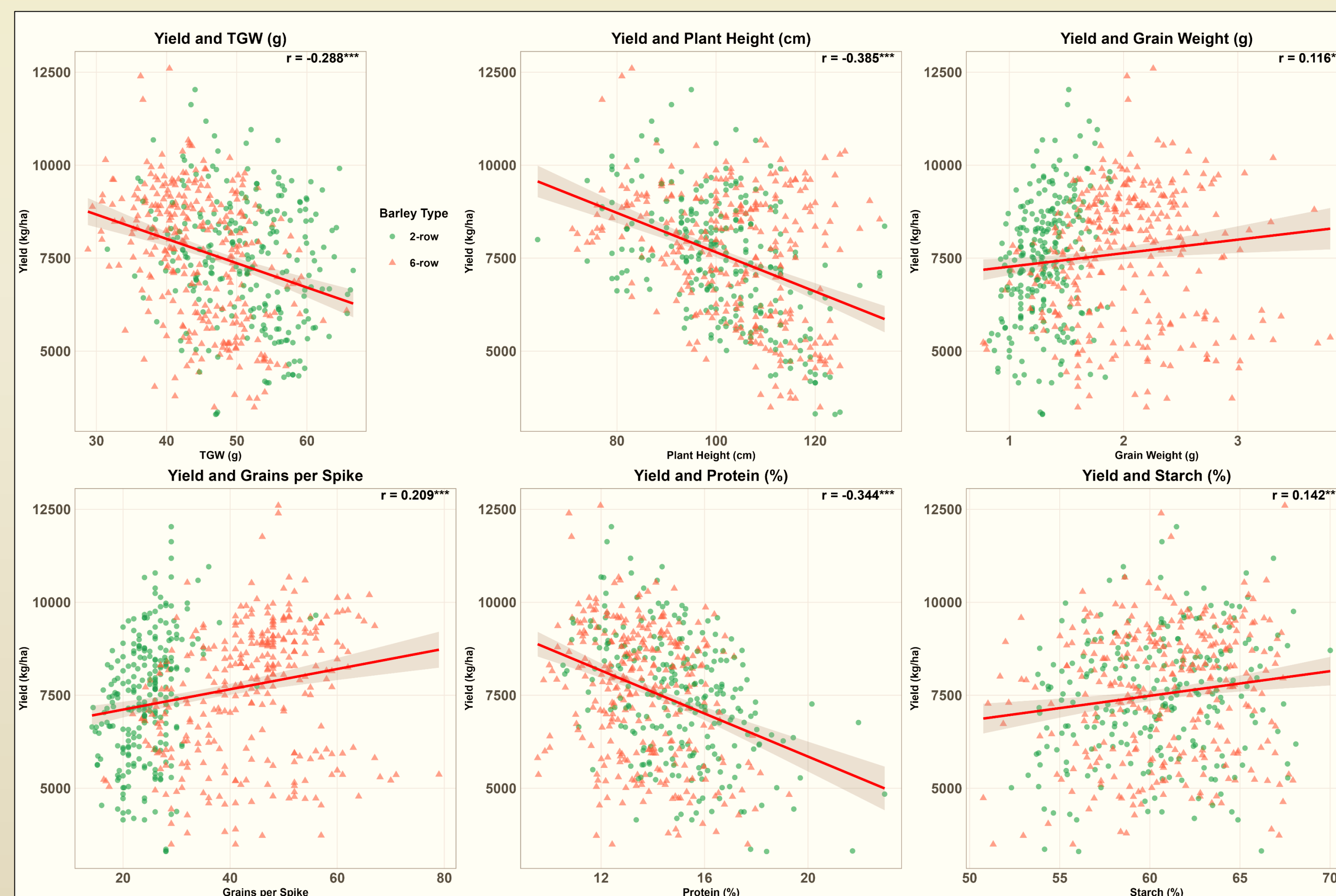


Figure 8. Yield and quality relationships in barley during 2024-2025 across 8 experimental sites

- ❖ Testing barley varieties across Romania's diverse growing regions shows that carefully selecting the right varieties for each area can significantly increase the country's total barley production. However, multiannual testing is essential because climatic conditions vary from year to year.
- ❖ Cadril variety consistent top three performance at five out of eight experimental sites highlighted that broad adaptation remains a valuable breeding target, offering farmers a reliable variety choice that performs well across diverse environmental conditions.

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