Supplementary Material S1. Research parameters in *Quercus robur*, with country attribution, interdisciplinary benefits and future research hypotheses.

Parameter/ Research Activity	**Serbia**	**Croatia**	**Interdisciplinary benefit (unique for each parameter)**	**Future research hypothesis (unique for each parameter)**	**Appropriate strategic action (from the *Conclusion* section of the paper)**	**References**
1. nSSR (nuclear microsatellite) diversity	Yes	Yes	Enables cross-country population connectivity modelling combining **genetics + landscape ecology**, essential for predicting gene flow corridors.	*Differences in allelic richness between Serbian and Croatian populations reflect micro-refugial structuring and will predict differential responses to future climatic extremes.*	1,2,4,7,8,9	Kesić et al. 2021, Popović et al. 2023, Trudić et al. 2021a, Katičić-Bogdan et al. 2018
2. cpSSR haplotype diversity	No	Yes - extremely high haplotype richness	Informs **post-glacial phylogeography + conservation genetics**, allowing integration of palaeoecology with modern breeding zones.	*Croatian maternal haplotypes indicate the persistence of refugial lineages with potential adaptive value under hydrological stress, whereas the absence of a harmonized assessment of Serbian haplotype diversity currently limits cross-border comparison and comprehensive phylogeographic interpretation of Quercus robur in the region.*	1,2,7,8,9	Popović et al. 2023, Katičić-Bogdan et al. 2018
3. SNP genotype–environment associations (candidate genes)	No	Yes - 37 SNPs linked to water-related variables	Supports integrated **genomics + climate science**, enabling prediction of adaptive genetic responses to water regime shifts.	*Environmental SNP signatures in Croatian populations are expected to correlate with distinct drought-response thresholds detectable via physiological assays. This analytical framework must be extended to Serbian populations as well, because Serbia occupies a complementary hydroclimatic and phylogeographic position within the Pannonian–Balkan transition zone, where contrasting*	1,2,4,5,6,7,8,9	Temunović et al. 2020

				groundwater regimes, floodplain dynamics and post-glacial lineage admixture may generate divergent genotype–environment–phenotype relationships that cannot be inferred from Croatian datasets alone.		
4. Leaf morphometric traits	Yes - detailed morphometry, stomatal traits, nutrient content	Yes – Western Balkan wide assessment and acorn morphometry	Provides a bridge between **phenotypic plasticity + silviculture**, directly informing selection of planting material for climate-adaptive forestry.	*Leaf morphological plasticity differs between Serbian and Croatian populations and predicts differential resilience to combined drought–heat stress.*	1,2,3,6,7,9	Franjić et al. 2000, Ballian et al. 2010, Batos et al. 2010, Ivanković et al. 2011, Batos et al. 2017, Škvorc et al. 2018, Kesić et al. 2022, Kesić et al. 2026.
5. Provenance trial and field experiment performance	Represented through 1 provenance in Croatian provenance trials	Yes - long-term, multi-site trials	Links **common-garden ecology + genetics**, enabling detection of genetic × environment interactions critical for breeding.	*Serbian and Croatian provenances will show divergent growth-stability trade-offs under standardized conditions, reflecting local adaptation signatures.*	4,5,6,7,8,9	Gračan et al. 1991, 1993, Gračan and Perić 1993, Perić 2001, Bogdan et al. 2004, Ivanković et al. 2011, Kajba et al. 2011, Bogdan et al. 2017, Đodan et al. 2024, Popović et al. 2024, Đodan et al. 2026
6. Physiological stress responses (drought/heat)	Yes	Less represented	Integrates **plant physiology + oxidative stress response + forest ecology**, improving dynamic modelling of	*Populations with higher intrinsic water-use efficiency in Serbia will display enhanced oxidative stress buffering under simulated heat waves. Testing Croatian populations is essential to*	1,2,3,4,6,7,9	Bojović et al. 2017a, Bojović et al. 2017b, Horak et al. 2019, Stojnić et al. 2019, Vastag

			climate-induced stress pathways.	*determine whether enhanced oxidative-stress buffering arises from convergent physiological responses or from lineage- and habitat-specific adaptive pathways shaped by contrasting floodplain dynamics and drought histories.*		et al. 2020, Kesić et al. 2023, Trudić et al. 2023, Škvorc et al. 2026.
7. Phenological stress response to drought and rootstock effect on intra-clonal variation in spring leaf phenology	No	Yes	Integrates **plant phenology + forest ecology and climate science,** in order to predict how drought-induced shifts in tree phenology influence forest productivity and resilience; Considering role of rootstock in shaping scion phenology	*The timing of drought modulates multi-year shifts in Quercus robur leaf phenology, influencing frost susceptibility and growth recovery across different provenances*	2,3,4,6,7,9	Čehulić et al. 2019, Bačurin et al. 2025, Bačurin et al. 2026
8. Psychological stress response to biotic stressors	Yes	No	Integrates **plant physiology + forest ecology,** improving understanding of biological agents to support sustainable forest resilience	*Changes in stomatal traits, photosynthetic pigments, and chlorophyll a fluorescence act as early, integrated protective responses of Q. robur seedlings under varying severity of biotic stressors*	1,2,3,4,6,7,9	Pap et al. 2014, Nikolić et al. 2019, Vastag et al. 2019, Vastag et al. 2022
9. Gene expression (transcriptomics)	Yes - Serbian samples analyzed for drought response	No	Merges **functional genomics + ecophysiology**, enabling mechanistic understanding of adaptive pathways.	*Differential expression of stress-responsive genes (e.g., ABA pathway) will predict provenance-level survival under multi-factor climate stress.*	2,4,5,6,7,8,9	Trudić et al. 2021b
10. Mycorrhizal associations	Yes	No	Combines **microbiology + tree physiology**, clarifying how symbionts mediate	*Variation in ectomycorrhizal community structure between Serbia and Croatia modulates*	4,5,6	Kebert et al. 2022b, Kebert et al. 2022c, Kebert et al. 2023

			resilience under soil moisture extremes.	*nutrient uptake and drought resilience*.		
11. Regional morphological comparisons (Western Balkan level)	Yes	Yes	Integrates **biogeography + morphometry**, identifying phenotypic clines aligned with hydrological and climatic gradients.	*Morphological variation across Western Balkan clines is partly genetically controlled and will correlate with hydroclimatic niche models.*	1,2,4,6,7,9	Ballian et al. 2010, Kesić et al. 2026
12. Adaptive potential under combined abiotic and biotic stressors	Yes	Yes	Creates an interdisciplinary nexus between **physiology + genomics + forest management**, essential for climate-smart breeding.	*Adaptive potential indicators (morphological + genomic + physiological) will collectively predict population survival probabilities in 2050 climate scenarios*.	1,2,3,4,5,6,7,8,9	Pilipović et al. 2020, Milanović et al. 2020