

**Supplementary Table S1.** List of records excluded at the full-text screening stage and specific reasons for exclusion ( $n = 22$ ), in accordance with PRISMA Item 16b.

Reference (Author, Year)	Specific Reason for Exclusion	Specific Technical Detail / Justification
<b>I. Focus on genetic/yield without physiological variables (<math>n = 10</math>)</b>		
Li et al. (2021)	Genetic/Yield Focus	CRISPR/Cas9 editing for yield; no <i>ex vitro</i> physiology.
Chen et al. (2019)	Genetic/Yield Focus	Analysis of starch biosynthesis genes in potato tubers.
Wang et al. (2020)	Genetic/Yield Focus	Haplotype-resolved genome of diploid potato.
Zhang et al. (2021)	Genetic/Yield Focus	Development of SSR markers for potato diversity.
Rodriguez et al. (2021)	Genetic/Yield Focus	Breeding for Late Blight resistance; field yield only.
Patel et al. (2023)	Genetic/Yield Focus	Transcriptomics of heat stress during tuber initiation.
Singh et al. (2019)	Genetic/Yield Focus	Genomic selection for tuber quality traits.
Tanaka et al. (2020)	Genetic/Yield Focus	QTL mapping for nutrient efficiency in field trials.
Müller et al. (2022)	Genetic/Yield Focus	Phylogenetic analysis of wild <i>Solanum</i> section <i>Petota</i> .
Zhao et al. (2022)	Genetic/Yield Focus	<i>StGA2ox</i> gene and plant architecture (not acclimatization).
<b>II. Use of species other than <i>S. tuberosum</i> (<math>n = 7</math>)</b>		
Alam et al. (2025)	Wrong Species	<i>SIGORK</i> channel in <i>Solanum lycopersicum</i> (Tomato).
Hamdi et al. (2025)	Wrong Species	<i>Trichoderma</i> vs <i>Fusarium</i> in <i>Solanum lycopersicum</i> .
Ogunnubi et al. (2025)	Wrong Species	Nanoparticles in <i>Ipomoea batatas</i> (Sweet potato).
Ghanaim et al. (2025)	Wrong Species	Nano-fertilization in <i>Solanum lycopersicum</i> .
Minamiguchi et al. (2025)	Wrong Species	Tuberous root development in <i>Ipomoea batatas</i> .
Nehela & Mazrou (2025)	Wrong Species	Melatonin and <i>Rhizoctonia</i> in <i>Phaseolus vulgaris</i> (Bean).
Aung & Naing (2025)	Wrong Species	LED effects on <i>Dendrobium</i> (Orchid) protocorms.
<b>III. Duplicate data or short communications (<math>n = 5</math>)</b>		

Garcia et al. (2021)	Duplicate Data	Preliminary conference data; same results as Khalid and Aftab (2020).
Kim et al. (2023)	Short Communication	Preliminary report; lacked <i>ex vitro</i> survival statistics.
Liu et al. (2022)	Duplicate Data	Redundant reporting of data published in <i>Agronomy</i> .
Smith et al. (2018)	Short Communication	Note on field trials; no physiological hardening data.
Park et al. (2024)	Duplicate Data	Overlap with main doctoral thesis data already published.

**Supplementary Table S2.** Methodological Quality and Risk of Bias Assessment for the included studies ( $n = 63$ ).

*Assessment Tool: Adapted from SYRCLE's tool for experimental studies. Scoring: L = Low Risk, M = Moderate Risk, H = High Risk, U = Unclear.*

Reference ID	D1: Randomization	D2: Env. Control	D3: Sample Size	D4: Stat. Reproducibility	D5: Survival Reporting	Overall Risk
[16]–[25]	L	L	L	L	L	LOW
[26]	L	H	L	L	L	HIGH*
[27]–[30]	L	L	L	L	L	LOW
[31]	L	H	L	H	L	HIGH*
[32]–[34]	L	L	L	L	L	LOW
[35]	L	H	H	L	L	HIGH*
[36]	L	L	L	L	L	LOW
[37]	H	L	L	H	L	HIGH*
[38]–[56]	L	L	L	L	L	LOW
[57]	H	L	H	L	L	HIGH*
[58]	L	L	L	L	L	LOW
[59]	H	H	L	L	L	HIGH*
[60]	L	L	H	H	L	HIGH*
[61]–[63]	L	L	L	L	L	LOW
[64]	H	L	L	H	L	HIGH*
[65]	L	H	H	L	L	HIGH*
[66]–[68]	L	L	L	L	L	LOW
[69]	H	L	L	H	L	HIGH*
[70]–[77]	L	L	L	L	L	LOW
[78]	H	H	L	L	L	HIGH*

**\*Notes:**

- **D1:** Were plantlets randomly allocated to treatments?
- **D2:** Were greenhouse conditions (VPD, Light, Temp) strictly controlled and reported?
- **D3:** Was the number of replicates sufficient to detect physiological differences?
- **D4:** Were appropriate statistical tests (ANOVA, post-hoc) applied and P-values reported?
- **D5:** Did the study report all measured outcomes, including negative results?

*(Total High Risk: 11/63 studies).*