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REVIEW

Saline Agriculture 3.0: reframing salinity for nutritional and quality-driven food value creation

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SUPPLEMENTARY MATERIALS

Table S1 Raw data and corresponding references (presented as an individual Excel sheet)

Note: For the data collection, saline conditions were defined as electrical conductivity of the saturated paste extract (ECe) $\geqslant$ 4 dS·m^{-1}, with 4 $\leqslant$ ECe < 8 dS·m^{-1} representing moderate and 8 $\leqslant$ ECe $\leqslant$ 16 dS·m^{-1} representing high salinity.

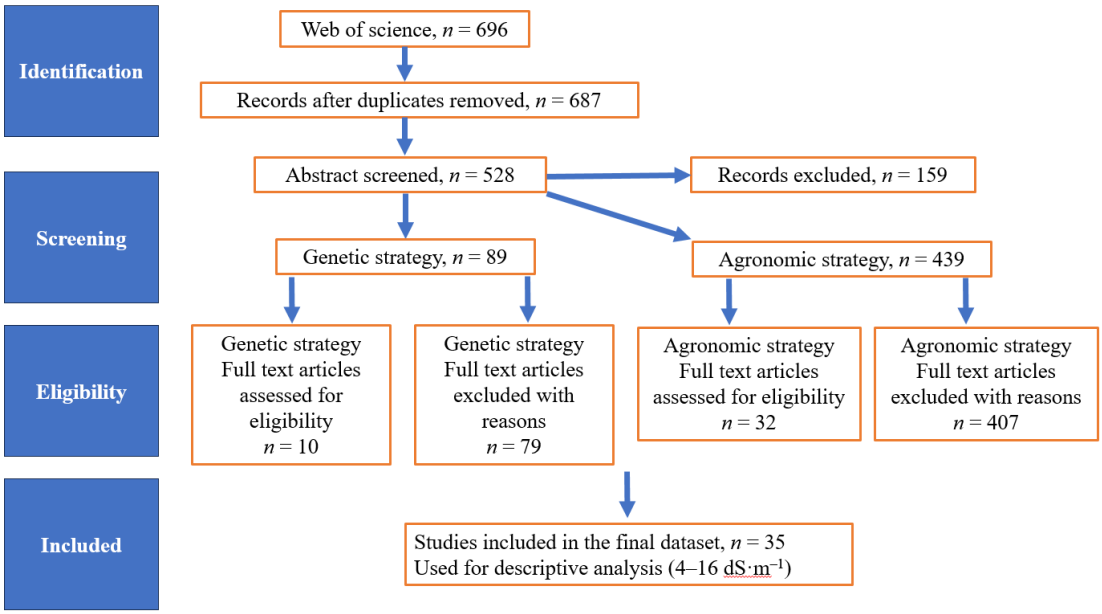


Fig. S1 Systematic search and screening process for the identification of eligible saline field studies. Study identification and selection were conducted through a systematic search of the Web of Science database on June 23, 2026, targeting peer-reviewed field studies reporting grain yield responses of wheat, maize, rice, and barley under natural saline conditions (ECe: 4–16 dS·m^{-1}). Two parallel search strategies were applied for genetic and agronomic interventions. The genetic strategy used the search string: ("saline soil" OR "sodic soil" OR "alkaline soil" OR "soil salinity" OR "ECe" OR "saline field") AND ("wheat" OR "maize" OR "rice" OR "barley") AND ("overexpression" OR "CRISPR" OR "genetic engineering" OR "transgenic" OR "gene editing" OR "salt-tolerant gene" OR "express*") AND ("field trial*" OR "field experiment*" OR "grain yield"). The agronomic strategy used the search string: ("saline soil" OR "sodic soil" OR "alkaline soil" OR "soil salinity" OR "ECe" OR "saline field") AND ("wheat" OR "maize" OR "rice" OR "barley") AND ("irrigation" OR "nutrient fertilization" OR "soil amendment" OR "crop rotation") AND ("field trial*" OR "field experiment*" OR "grain yield"). Identified records were screened for relevance and eligibility, and eligible studies were retained for data extraction. The final dataset comprised 35 studies, with the source studies listed in Table S1.

Table S2 Paired yield–quality responses for representative cereals under moderate (M) and high (H) soil salinity

Crop	Salinity level ($dS \cdot m^{-1}$)	Quality trait	Grain yield change (%)	Quality change (%)	Absolute quality range (%)	Product differentiation tendency	Data source
Wheat	Control (0)	Protein	0	0	10.0–11.9	Biscuit/cake (< 11%) → Bread (≥ 11%)	Tables 1 and 2 across 4 genotypes[1]; protein requirement for contrasting usage[2]
	M (7.5)		−25.6	6.2	10.5–12.7	Biscuit/cake (< 11%) → Bread (≥ 11%)	
	H (15)		−50.7	17.2	12.0–13.4	Bread (≥ 11%)	
Rice	Control	Amylose	0	0	N.A.	N.A.	Figures 3 and 8 by Meta-analysis[3]; amylose requirement for rice texture[4]
	M (4−8)		−40.5	−14.5	N.A.	Lower amylose → Softer, stickier (directional)	
	H (≥8)		−72.1	−1.5	N.A.	Higher amylose →Firmer, less-sticky (directional)	
Barley	Control (0)	Protein	0	0	11.0–14.2	Malting (10.5–12.5%) → Food/feed (> 13%)	Tables 2 and 6 across 6 genotypes[5]; protein requirement for contrasting usage[6]
	M (7)		−24.5	28.7	15.0–18.6	Food/feed (> 13%)	
	H (14)		−41.0	30.9	15.8–18.5	Food/feed (> 13%)	

Note: Grain yield and quality changes (%) were calculated as 100 × (treatment − control) / control using paired control–treatment data. For wheat and barley, yield and quality changes represent means across the reported genotypes, whereas absolute quality values are reported as the observed ranges across genotypes; rice values are derived from a published meta-analysis, where absolute amylose values for rice were not available; end-use directions are indicated as directional tendencies only. For rice, “higher” and “lower” refer to comparisons between moderate and high salinity treatments, not to the non-saline control. The “Product differentiation tendency” column indicates a potential direction of product differentiation associated with the observed quality-trait change, rather than demonstrated processing, sensory, nutritional, or market performance. Positive or negative quality changes are therefore not inherently beneficial or detrimental; their implications depend on the specific trait, its absolute level, and the intended end use. These paired responses were used to construct Fig. 3.

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