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**POPULAR ARTICLE**

**Plant breeding today and tomorrow**

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Plant breeding today uses advanced genomics, molecular markers, and genomic selection for faster, more precise trait improvement, tackling challenges like climate change and nutrition, while tomorrow's breeding will see even deeper integration of 'omics' data, AI-driven predictions, gene editing (like CRISPR) for rapid trait development, and highly specialized breeding services, leading to hyper-efficient, tailored crops for diverse environments, though cost and access remain key factors.

**Plant breeding today: Genomic revolution and Precision**

**Genomic selection (GS):** Using DNA markers to predict plant performance, speeding up selection for complex traits (yield, stress tolerance).

**Omics technologies:** Integrating genomics, proteomics, and metabolomics to understand traits better and identify target genes.

**Molecular breeding:** Using molecular markers to select for desirable genes, reducing reliance on traditional, slower field trials.

**New breeding technologies (NBTs):** Techniques like CRISPR-Cas9 enable precise gene editing, creating new varieties faster than traditional GMO methods, sometimes without being classified as GMOs.

**Focus:** Climate resilience (drought, heat), improved nutrition (biofortification), pest/disease resistance, and higher yields for food security.

**Plant breeding tomorrow:** AI, gene editing and specialization

**AI and machine learning:** Predicting complex gene interactions, optimizing breeding strategies, and accelerating variety development.

**Deep gene editing:** Wider application of CRISPR for precise edits, creating plants with entirely new traits or enhanced existing ones.

**Hyper-specialized services:** A shift where breeders might focus on specific traits or platforms, with data-driven service providers entering the market.

**Integration of 'Omics':** Full exploitation of multi-omics data for predictive breeding, creating highly detailed crop profiles.

**Challenges:** High costs of advanced tech, ensuring equitable access, and navigating regulatory landscapes for edited organisms.

**The "Why" for tomorrow climate change adaptation:** Developing crops that thrive in unpredictable weather, conserving water, and resisting new pests.

**Sustainable intensification:** Producing more food with fewer inputs (water, fertilizer).

**Nutritional security:** Engineering crops with enhanced vitamins, minerals, and healthier profiles.

In essence, plant breeding is moving from observation and selection to precise genetic engineering and data-driven design, ensuring resilient and nutritious food for a growing world facing unprecedented environmental changes.