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Castor Breeding: Principles, Practices, Objectives, Traits, Challenges, and Advancements

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Abstract:

The castor bean is a vital industrial oilseed crop valued for its high ricinoleic acid content and diverse commercial applications. This paper reviews the principles, practices, objectives, and challenges of castor breeding, emphasizing hybridization, mutation, and selection methods alongside modern tools such as marker-assisted selection, genetic transformation, and omics technologies. Key breeding objectives include enhancing oil yield and quality, developing resistance to biotic and abiotic stresses, improving plant architecture for mechanized harvesting, and reducing toxic compounds like ricin and allergens. Despite limitations posed by narrow genetic diversity, complex sex expression, and biosafety concerns, recent advancements—such as genome sequencing, molecular marker development, and transgenic approaches—have accelerated progress in castor improvement. The study highlights future directions in broadening the genetic base, strengthening climate resilience, and integrating sustainable practices to ensure the crop's global relevance and economic value.

Keywords: Castor breeding, Genetic improvement, Hybridization, Marker-assisted selection

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