Molecular Markers for Selective Breeding of Fruit Skin Color in Date Palms

Reliable and cost-effective approach for precise breeding of date palms.

Technology

Researchers in the Purugganan Lab at NYU Abu Dhabi have developed a PCR-based marker system using proprietary oligonucleotide primers to accurately genotype VIRESCENS alleles, key determinants of fruit skin color, for selective breeding of date palms (*Phoenix dactylifera* L.). The NYU inventors have previously reported (*Hazzouri et al. Nat Commun 2019*) that the VIRESCENS locus, controlling anthocyanin biosynthesis, is the primary genetic factor determining fruit color variation. The marker system is centered on a series of four PCR reactions capable of distinguishing six genotypes at the VIRESCENS locus. The system employs a two-stage process: Stage 1 differentiates alleles based on the presence of an LTR-retrotransposon insertion, while Stage 2 uses a Mismatch Amplification Mutation Assay (MAMA-PCR) to detect SNP variations at the translation initiation codon. Cross-platform validation has shown full concordance between this PCR method and Illumina sequencing, demonstrating its robustness and reliability. The ability to predict 'khalal' stage fruit color, determined by these alleles, provides a valuable tool for breeding programs aiming to select desirable parent plants and seedling progeny. This system is designed to be simple and cost-effective for deployment in any molecular biology laboratory, enabling precise identification of genotypes that influence fruit color at the 'khalal' stage. In conclusion, this diagnostic approach has the potential to streamline the breeding selection process by enabling precise marker-assisted selection of genotypes favored for their fruit color, reflecting consumer preferences and regional demands.

Background

Date palms are a major fruit crop in North Africa, West Asia, and other arid regions, where fruit skin color significantly impacts commercial value. The transition from green to red, yellow, or intermediate colors occurs at the 'khalal' stage, approximately 17 to 20 weeks post-pollination. Current breeding practices for date palms rely heavily on vegetative propagation, with limited resources available for genotyping assays. The existing standard of care lacks precise molecular markers for organoleptic traits such as fruit color, hindering efficient breeding for improved varieties. Molecular markers for fruit traits are essential, as they facilitate the identification of desirable genotypes when direct observation is impractical, such as in dioecious species or young seedlings. This technology addresses the unmet need for reliable, cost-effective genotyping methods, enabling the prediction and selection of fruit color traits in breeding programs.

Applications

Technology ID

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Category

Life Sciences/Agriculture

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- Marker-assisted selection for:
  - Screening of date palm genotypes at any stage of development
  - Genotyping date palm seedlings for fruit color prediction
  - Selecting male and female genotypes for breeding

Advantages

- **Cost-effective:** PCR-based genotyping enables widespread deployment in resource-limited settings.
- **High accuracy and reliability:** Validated with 100% concordance in cross-platform studies.
- **Codominant allele distinction:** Differentiates three alleles with simple PCR reactions.
- **Facilitates marker-assisted breeding:** Enhances selection of desirable genotypes in breeding programs.
- **Suitable for fingerprinting applications:** Ensures true-to-type validation of offshoots or micropropagated materials

Intellectual Property

NYU has filed a U.S. provisional patent application covering the method of using oligonucleotide primers to predict the color of a date fruit plant (e.g. date palm) at the khalal stage.

References

1. Hazzouri, Khaled M et al. , https://pubmed.ncbi.nlm.nih.gov/26549859/