

Ensuring Genetic Integrity: The Role of DUS Testing in Pearl Millet Variety Development and Protection

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Pearl millet (*Pennisetum glaucum* L.) is a vital cereal crop cultivated in arid and semi-arid regions for its resilience, nutritional value, and adaptability. With the regulated release of new varieties, there is an increasing need to ensure that these varieties are distinct, uniform, and stable criteria evaluated through DUS (Distinctness, Uniformity, and Stability) testing. DUS testing also plays a crucial role in plant variety protection after release. This article explores the importance of DUS testing in pearl millet, outlines its methodology, and highlights its impact on variety development, genetic resource conservation, and the legal protection of breeders' rights.

Keywords: Distinctness, Uniformity, Stability

Introduction

Pearl millet is a key food and fodder crop in several parts of Asia and Africa, known for its exceptional tolerance to drought, high temperatures, and poor soil fertility. As breeding programs increasingly focus on improving yield and resilience, the development of stable and high-performing varieties has become essential. For a new variety to be released, registered, and protected under plant breeders' rights, it must undergo DUS testing—a globally recognized method to assess Distinctness, Uniformity, and Stability.

DUS Testing

DUS testing is a formal procedure used to determine a new plant variety based on following three characters:

1. **Distinctness:** Can be clearly distinguished from any other known variety.
2. **Uniformity:** Shows consistent characteristics among individual plants within a variety.
3. **Stability:** Retains its defining characteristics over successive generations or propagation cycles.

The DUS criteria are mandatory for variety registration under organizations like UPOV (International Union for the Protection of New Varieties of Plants) and national systems such as the Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act in India.

Methodology of DUS Testing in Pearl Millet

DUS testing in pearl millet primarily involves morphological characterization under field conditions by following standardized guidelines, some of the key guidelines are as follow.

1. Selection of Test Genotypes:

- Candidate variety
- Reference or comparator varieties (already known and registered)

2. Field Trials:

- Trials conducted over at least two growing seasons and/or locations.
- Standard spacing, agronomic practices, and randomized designs are followed.

3. Trait Evaluation:

Typical DUS traits in pearl millet include:

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| 1. Anthocyanin coloration of first leaf sheath | 14. Spike shape |
| 2. Days to 50% flowering | 15. Spike tip sterility |
| 3. Sheath pubescence | 16. Spike density |
| 4. Sheath length | 17. Number of productive tillers |
| 5. Node pubescence | 18. Plant height (excluding spike) |
| 6. Number of nodes | 19. Growth habit |
| 7. Node pigmentation | 20. Leaf blade, length and width |
| 8. Internode pigmentation | 21. Inflorescence shape & length |
| 9. Spike exertion | 22. Anther colour |
| 10. Spike length | 23. Flowering time |
| 11. Spike bristle | 24. Maturity period. |
| 12. Bristle colour | 25. Spike: Girth at max. point |
| 13. Grain shape, and colour, weight of 1000 grains | |

4. Scoring and Statistical Analysis

- Traits are scored on quantitative or qualitative scales.
- Statistical methods (like standard deviation and coefficient of variation) are used to assess uniformity and stability.

Significance in Variety Development

DUS testing serves several crucial functions in pearl millet improvement:

- **Facilitates Variety Release:** DUS data supports the identification and registration of improved varieties with desirable traits.
- **Promotes Genetic Purity:** Ensures that released varieties are phenotypically consistent, which is essential for seed production and certification.
- **Encourages Breeding Innovation:** By protecting new varieties under legal frameworks, DUS testing incentivizes breeders to invest in research and development.
- **Supports Farmers' Choice:** Distinct and stable varieties help farmers choose the best options for their agro-climatic conditions and markets.

DUS and Intellectual Property Rights (IPR)

In India breeders can claim legal rights over their varieties under PPV&FR Act. This prevents unauthorized commercial use of the variety and allows breeders to earn royalties. However, for claiming benefits under this Act, it is necessary to meet out the DUS criteria. Thus, DUS acts as a key component in balancing innovation and equity.

Challenges and Future Perspectives

- **Environmental Influence:** Phenotypic traits used in DUS testing can be influenced by environmental factors, potentially affecting consistency across trials.
- **Need for Molecular Markers:** Incorporating genotypic or molecular characterization (e.g., DNA fingerprinting) can complement morphological DUS data for more precise variety identification.
- **Standardization Issues:** Harmonization of DUS testing procedures across institutions and countries is still a challenge.

Despite these hurdles, advancements in phenomics and genomics are expected to enhance the accuracy and efficiency of DUS testing in pearl millet and other crops.

Conclusion

DUS testing is a foundational step in the lifecycle of variety development in pearl millet. By ensuring that new cultivars are distinct, uniform, and stable, DUS testing enhances genetic integrity, protects breeders' innovations, and ultimately contributes to agricultural sustainability and food security. As plant breeding technologies evolve, integrating traditional DUS methods with modern molecular tools will further strengthen the varietal evaluation process and accelerate the development of resilient, high-performing pearl millet cultivars.