

# Transforming Sustainable Agriculture: Enhancing Sorgoleone Production in Leading Sorghum Varieties to Tackle Nitrogen Loss

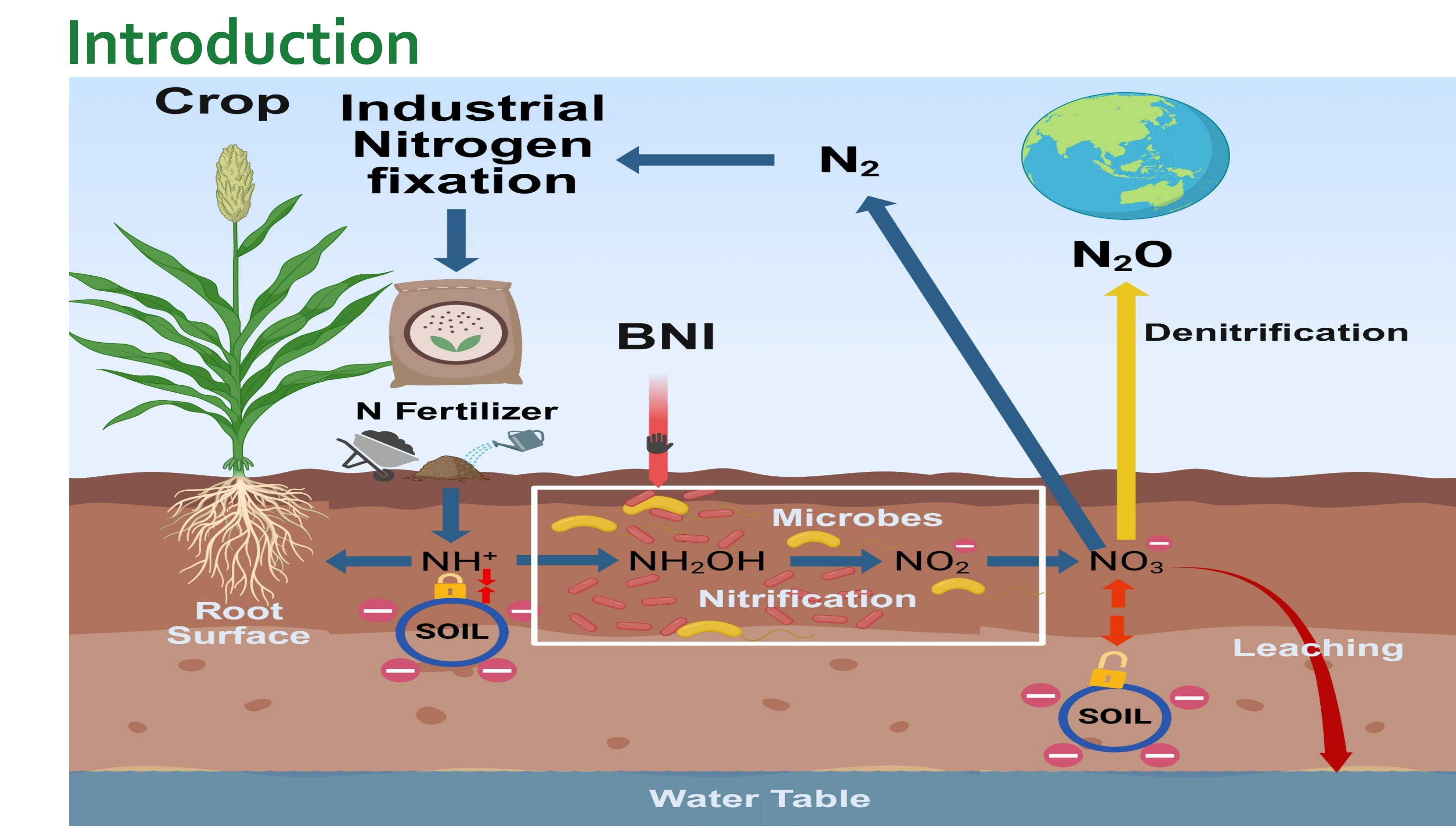
<sup>1</sup>Pramod Sargar, <sup>1</sup>Sonal Chavan, <sup>1</sup>Sunita Gorthy, <sup>1</sup>Damaris Odeny, <sup>1</sup>Ephrem Habyarimana\*

<sup>1</sup>International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru-502324, Telangana, India

\*Corresponding author: Ephrem.Habyarimana@icrisat.org

**Abstract**

Efficient nitrogen (N) management is crucial for sustainable sorghum production. Biological Nitrification Inhibition (BNI), driven by root exudates like sorgoleone, suppresses nitrifying bacteria, reducing nitrogen losses and improving soil health. A three-season study with 19 sorghum genotypes across four nitrogen regimes showed that lines with high sorgoleone production achieved similar grain and biomass yields at 50% and 100% nitrogen levels, indicating better nitrogen-use efficiency (NUE) and less fertilizer reliance. To explore the genetic basis of these traits, mapping populations are being developed, and two SNPs linked to sorgoleone production have been identified for marker-assisted breeding. These findings highlight BNI's potential as a climate-smart strategy to improve sorghum productivity and sustainability.

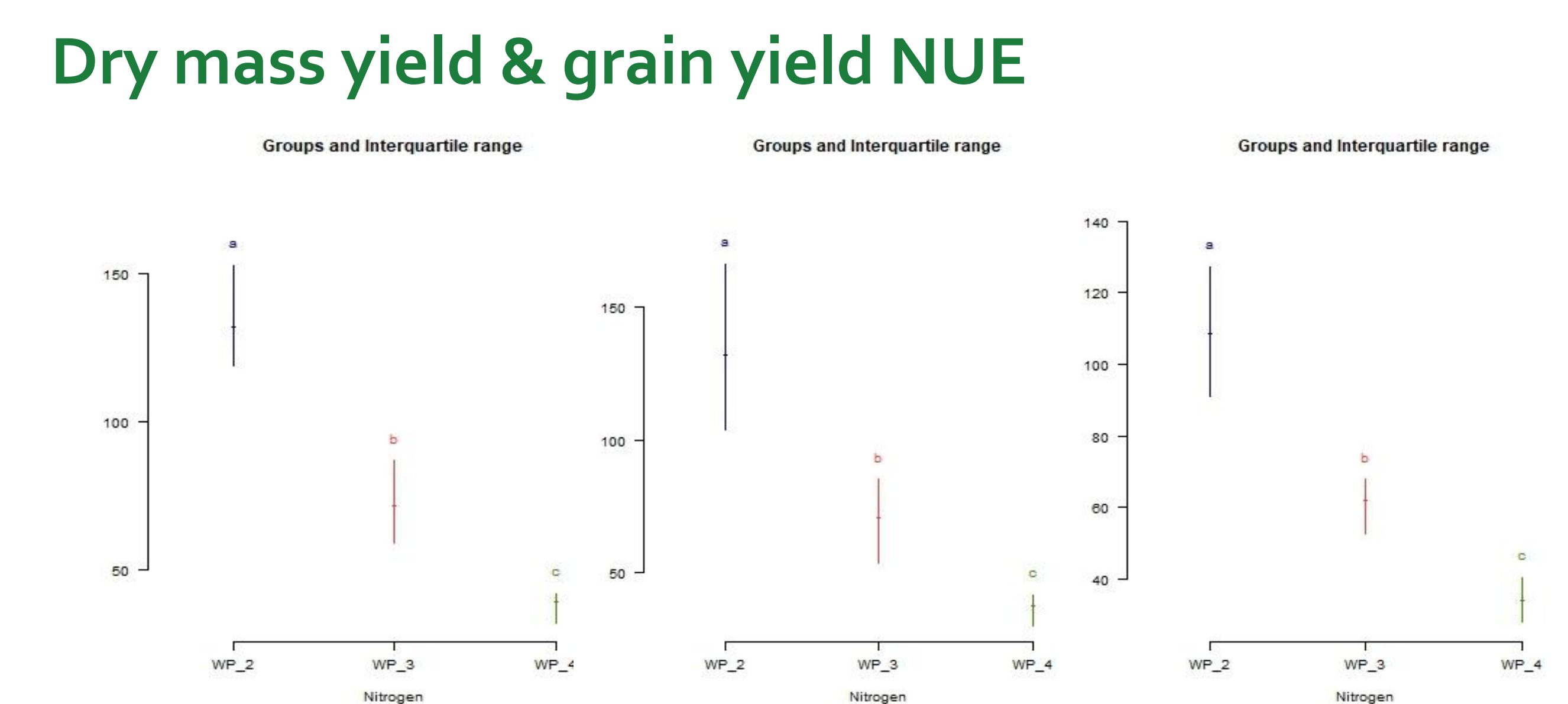
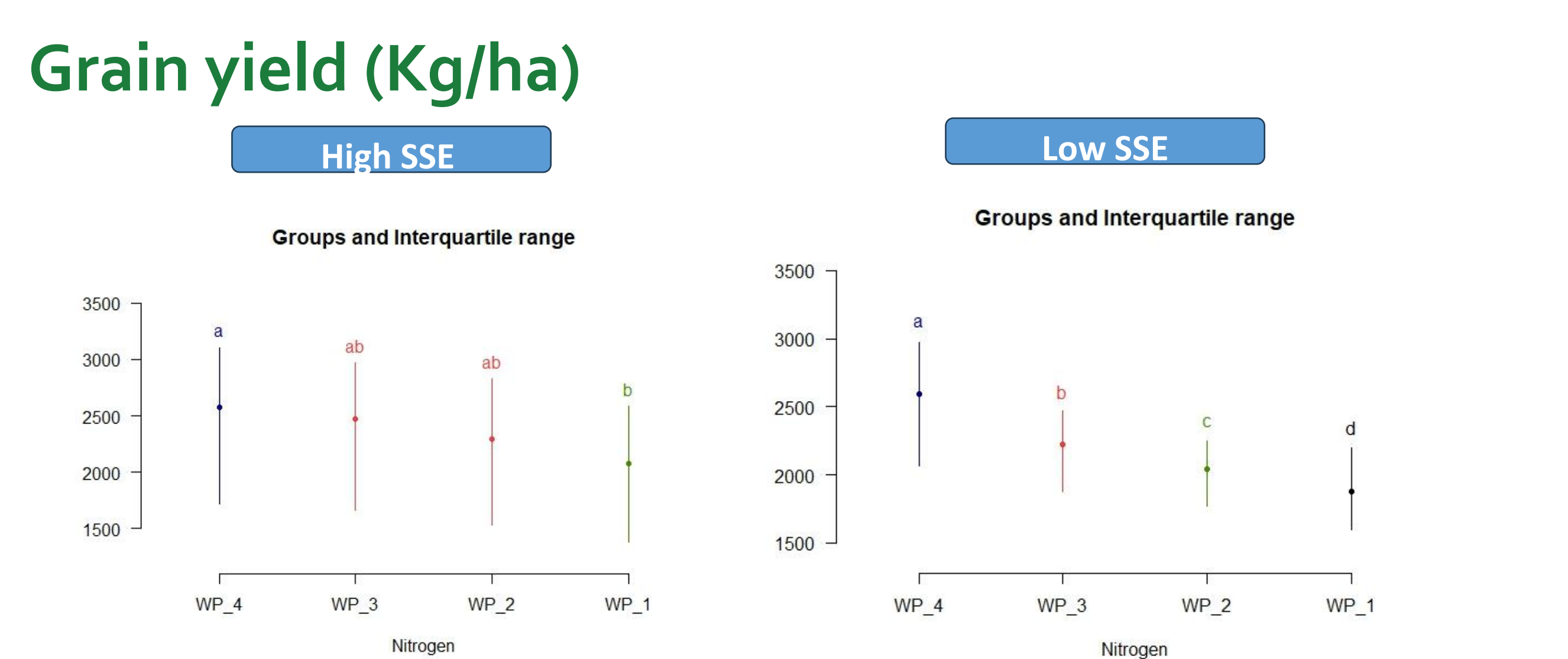
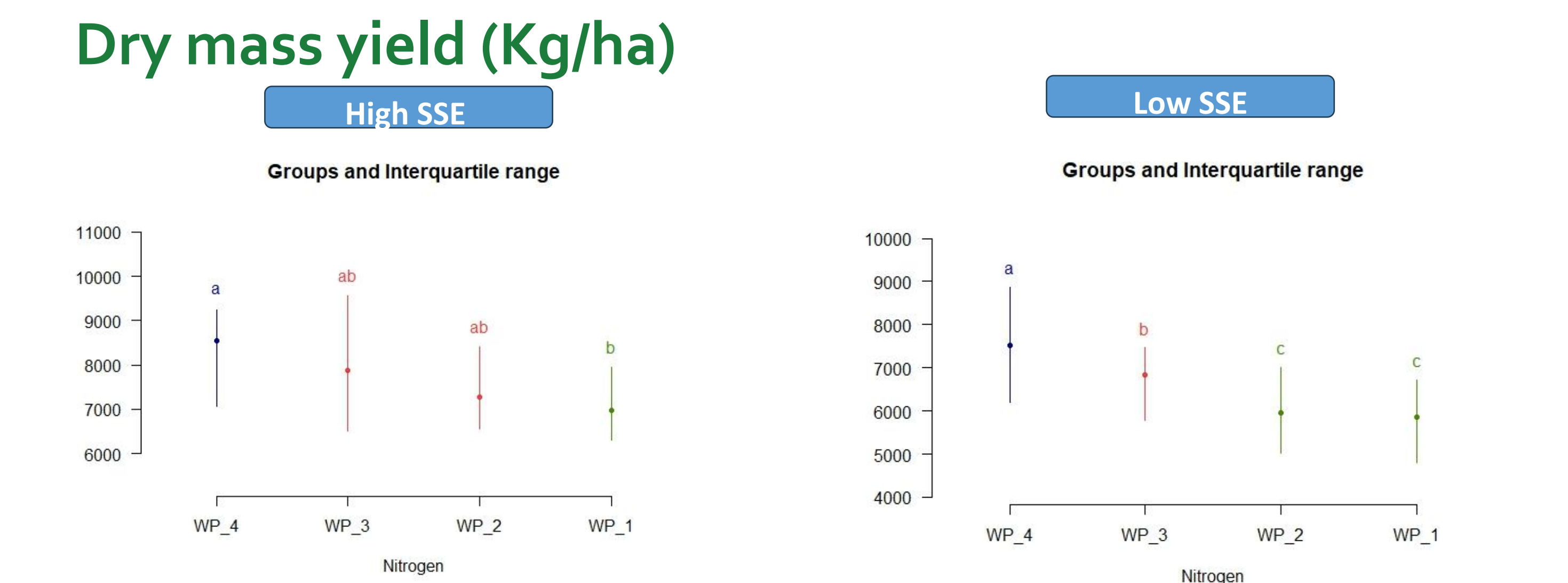


**Materials and Methods**

- 13 (8 high SSE, 5 low SSE) test entries, six FPV checks were evaluated in 3 Seasons: PR2023, R2024, and PR2024 using a split-plot design with two replications.
- Treatments: 0 (WP1), 0.5 x (WP2); 1 x (WP3), and 2 x (WP4) recommended dose.
- Developing BNI mapping populations and MABC: The recurrent parents were recently released cultivars, while four high-Sorgoleone lines served as donor parents.

**Results**

Nitrogen response as a function of Sorgoleone expression (specific sorgoleone content mg/g root DW). Bars with the same letters are not statistically different.



		Donor Parent			
S.No	Parents used for RIL Devel.	Sorgoleone per plant µg / plant	Crosses Generated		Parents
1	IS 28389	47.7	Female	2023PR	IS 15478 (53.6*)
2	IS 27786	41.24		2023PR	IS 28389 (47.7*)
3	IS 2902	38.17		2023PR	IS 29606 (45.3*)
4	IS 33353	33		2023PR	IS 22294 (41.46*)
5	IS 29606	45.3		2023PR	
6	IS 31681	38.42		2023PR	
7	IS 15478	53.6		2024PR	
8	IS 22294	41.46		2024PR	
9	IS 602	5.53	Male		

Table: List of parents used for developing mapping population and their sorgoleone concentration

• Dots indicate crosses produced  
\* Sorgoleone conc. in (µg/plant)

**Conclusions & Way Forward**

- 5 BNI lines identified: 3 dual-purpose & 2 forage types.
- BNI function halves the recommended nitrogen dose.
- The BNI function is optimal in the post-rainy season.
- Outlook #01: Promoting superior BNI lines and scaling superior FPVs with enhanced BNI functionality.
- Outlook #02: Identification and integration of sorghum BNI markers for marker-assisted selection.