

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

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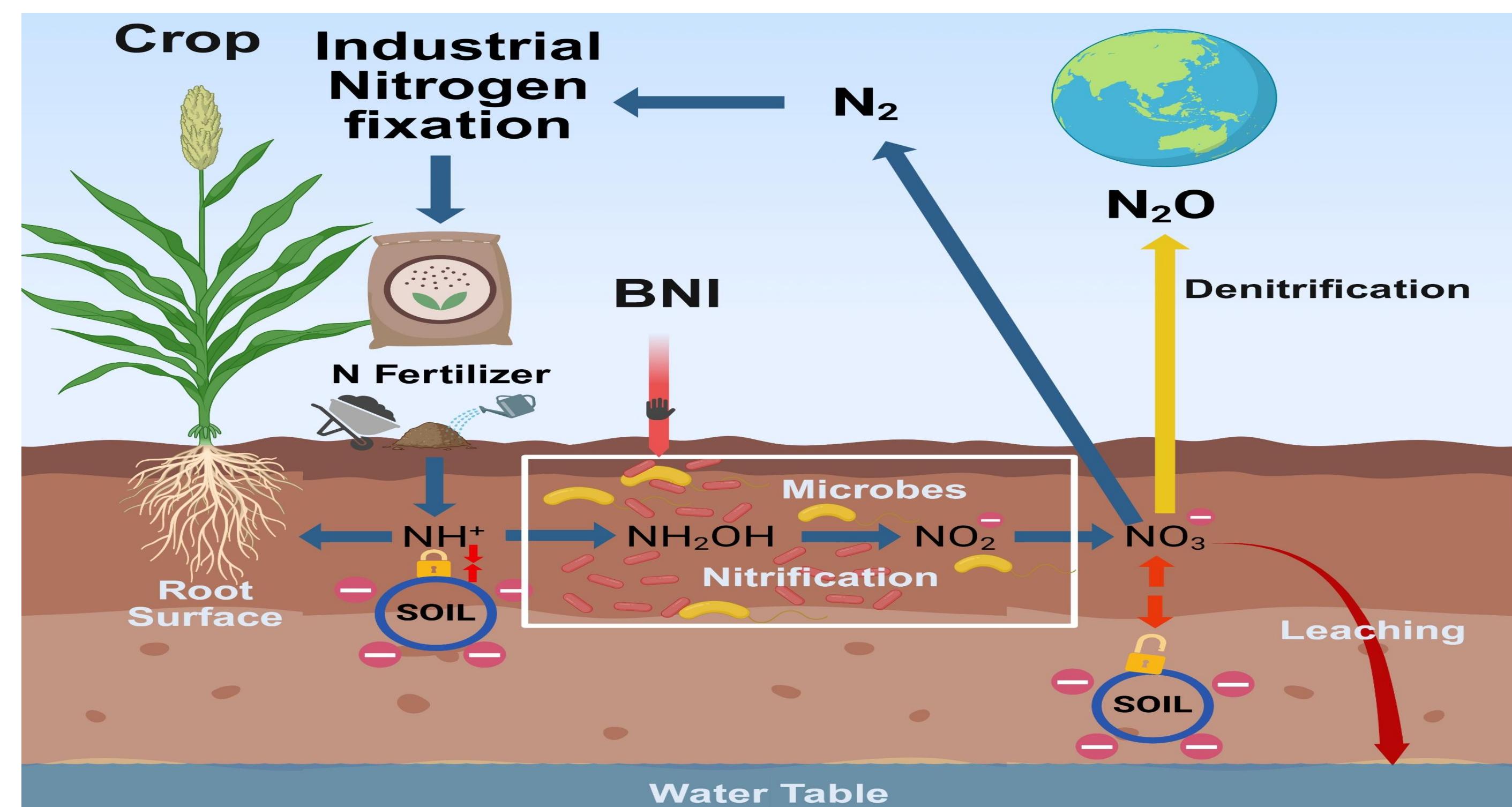
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Abstract

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.

Introduction



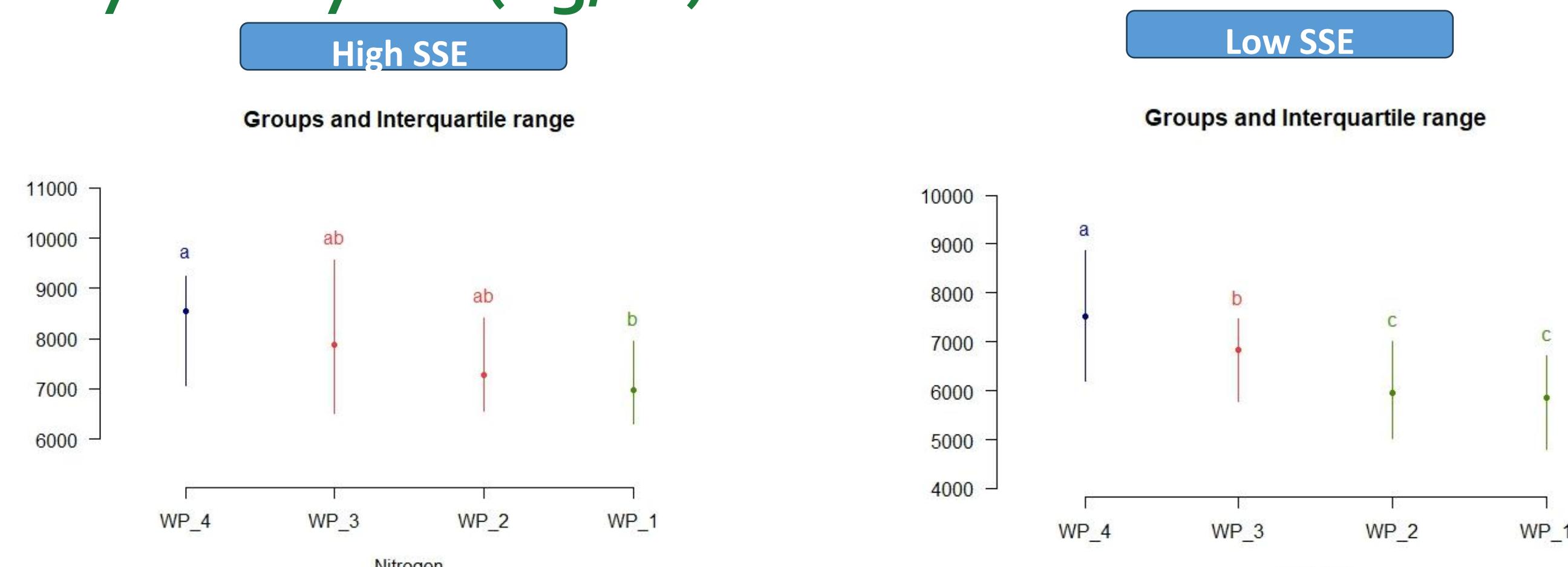
Materials and Methods

- 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.

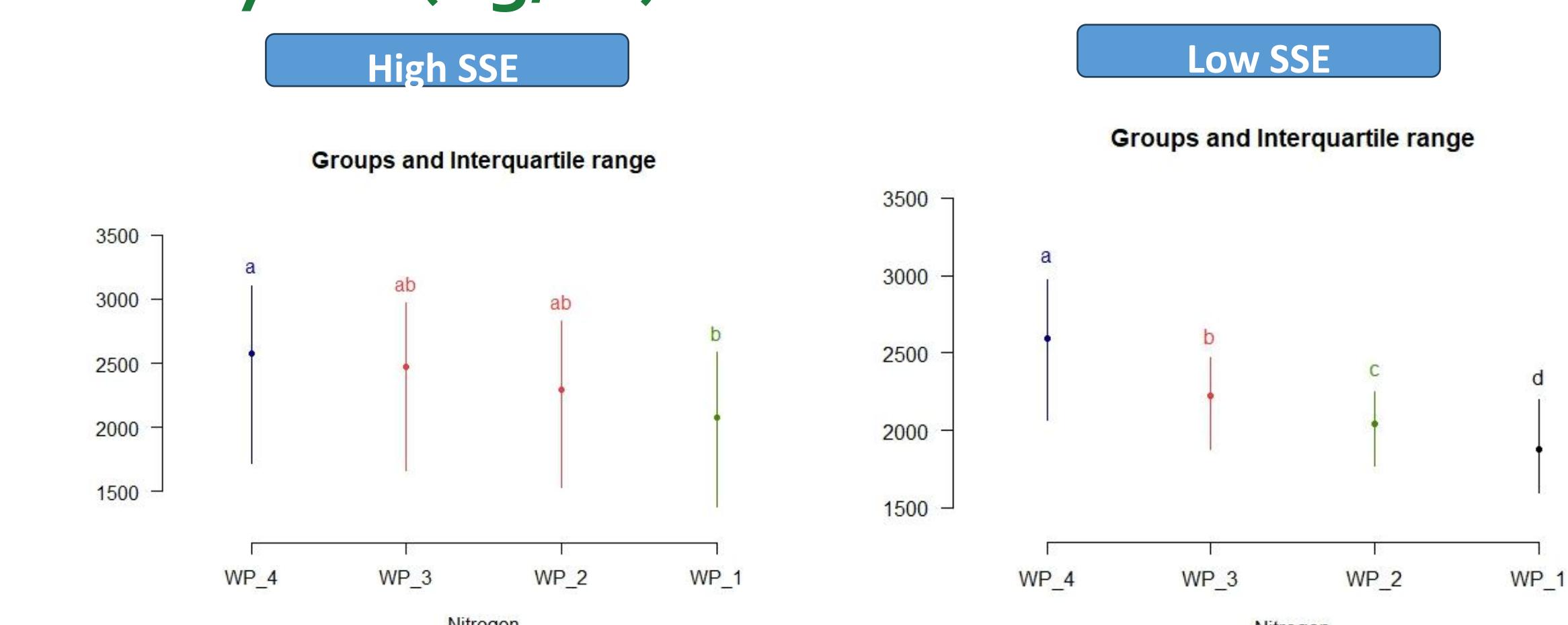
Results

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

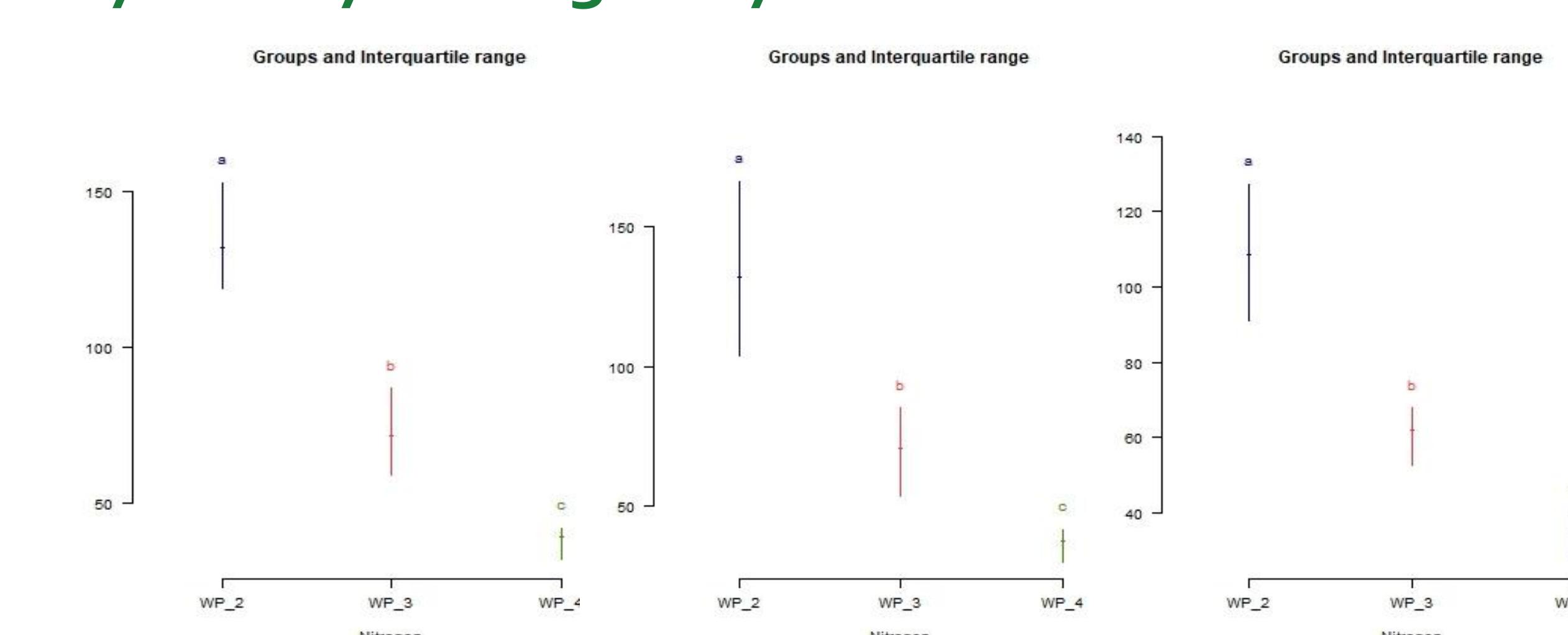
Dry mass yield (Kg/ha)



Grain yield (Kg/ha)



Dry mass yield & grain yield NUE



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

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

Parents	IS 15478 (53.6*)	IS 28389 (47.7*)	IS 29606 (45.3*)	IS 22294 (41.46*)
MACIA	•	•	•	•
KARI Mtama1		•	•	•
M35-1	•	•	•	•
ICSR 14001	•	•	•	•
CSV 48 (Jaicar Urja)	•	•	•	•
CSV-37	•	•	•	•
PYPS 2	•	•	•	•
SPV 2407	•	•	•	•
Phule Revati (RSV 1006)	•	•	•	•

• Dots indicate crosses produced

* Sorgoleone conc. in (μ g/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.