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Introduction

Understanding nitrogen (N) use efficiency (NUE) changes and physiological strategies for corn and sorghum will facilitate improvements in plant N uptake and their related efficiencies, which can consequently impact crop productivity.

Materials and Methods

The study of the grain N sources, herein understood as the 1) reproductive-stage shoot N remobilization (Remobilized N), 2) reproductive-stage whole-plant N uptake (Reproductive N), and 3) vegetative-stage whole-plant N uptake (Vegetative N), is a novel approach for investigating NUE changes from a plant physiological viewpoint. A scientific summary was performed with the goal of comparing NUE and N related efficiencies in corn versus sorghum. A historical summary published for corn (Ciampitti and Vyn, 2012; 2013; 2014) and a previous research study (4 site-yrs) involving six sorghum hybrids with varying genetic backgrounds and 3 fertilizer N rates were all utilized for this summary (Mahama and Prasad, 2014).

Results

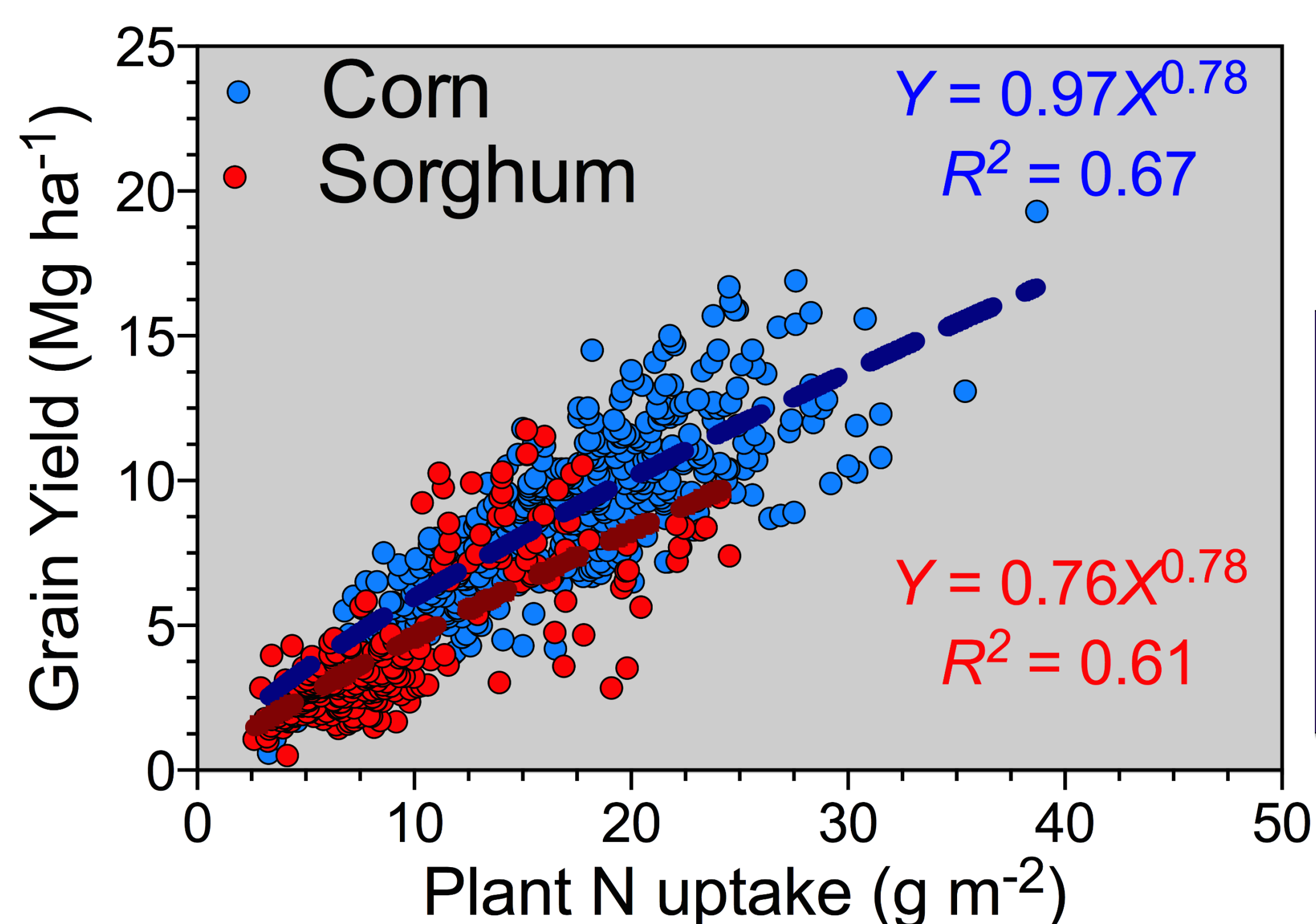
A summary with the information comparing corn vs. sorghum is presented in the below table.

Table 1. Summary of yield and N uptake traits for corn and sorghum.

Crop	GY (Mg ha ⁻¹)	PNU (g m ⁻²)	Nrem (g m ⁻²)	VegN (g m ⁻²)	RepN (g m ⁻²)	NIE (kg kg ⁻¹)	Grain %Nc
Corn (n = 526)	8.7	16.8	4.5	11.1	5.7	53	1.20
Sorghum (n = 288)	4.0	8.8	4.5	7.4	1.4	47	0.99

Were GY is the grain yield at maturity, PNU is the plant N uptake at maturity, Nrem is the N remobilization (stover N content at maturity minus VegN), VegN is the Vegetative N (whole-plant N content at flowering), RepN is the Reproductive N (PNU minus VegN), NIE is the N internal efficiency (GY to PNU ratio at maturity), and Grain %Nc is the grain N concentration at maturity.

The relationship between grain yield and whole-plant N uptake at maturity presented a curvilinear response, depicting a higher efficiency in increasing yields per unit of N taken up for corn as compared with sorghum at varying yield levels (Fig. 1).



Similar model (= exp. coef.), but ↑ NIE for corn

Results (continued)

The primary outcomes for the comparison were: 1) Remobilized N was primarily associated with Vegetative N in both crops (with similar R²s, >0.6 units); 2) for the association established between Remobilized N and Vegetative N, a similar slope (0.6-0.7X) was documented for both crops, suggesting comparable physiological response for these plant processes and depicting similar potential for NUE improvement, (Fig. 2A, B).

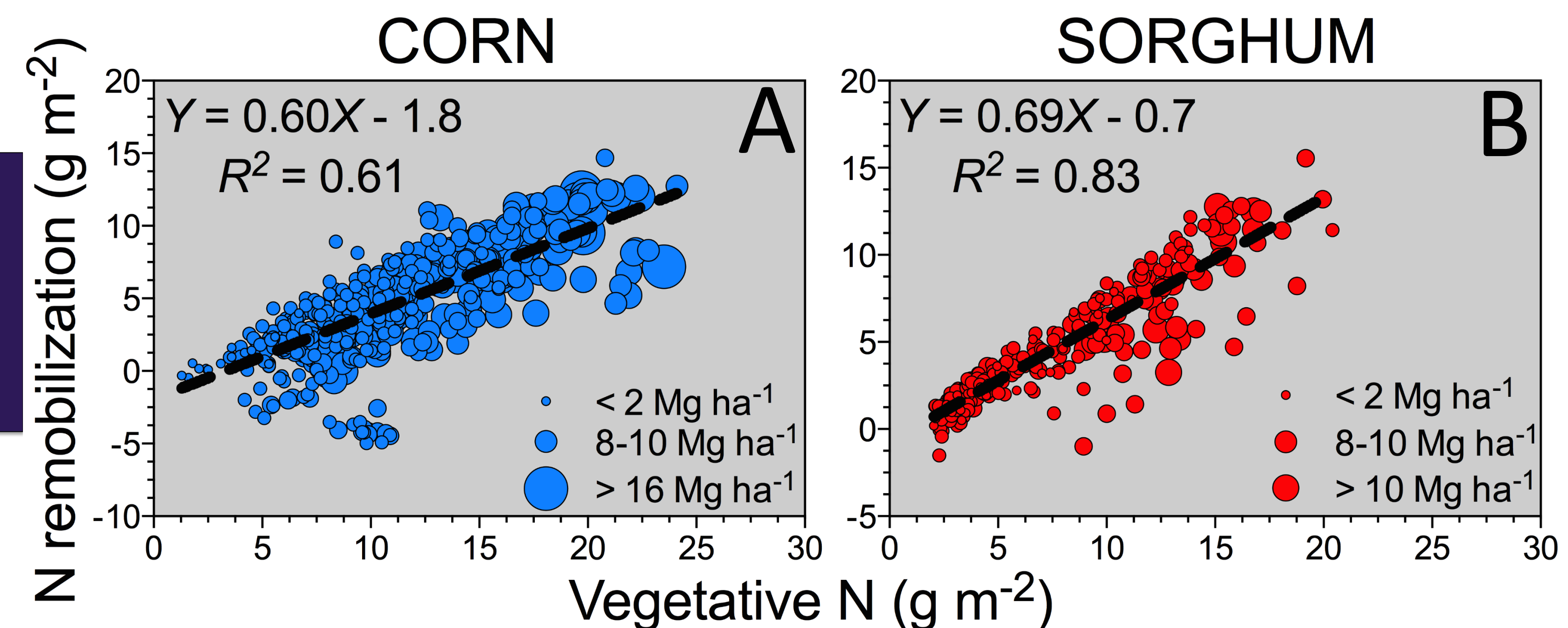


Figure 2. Relationship between nitrogen (N) remobilization and Vegetative N for corn (A) and sorghum (B).

3) A trade-off between Remobilized N and Reproductive N was documented, suggesting a complex plant regulation processes (source:sink).

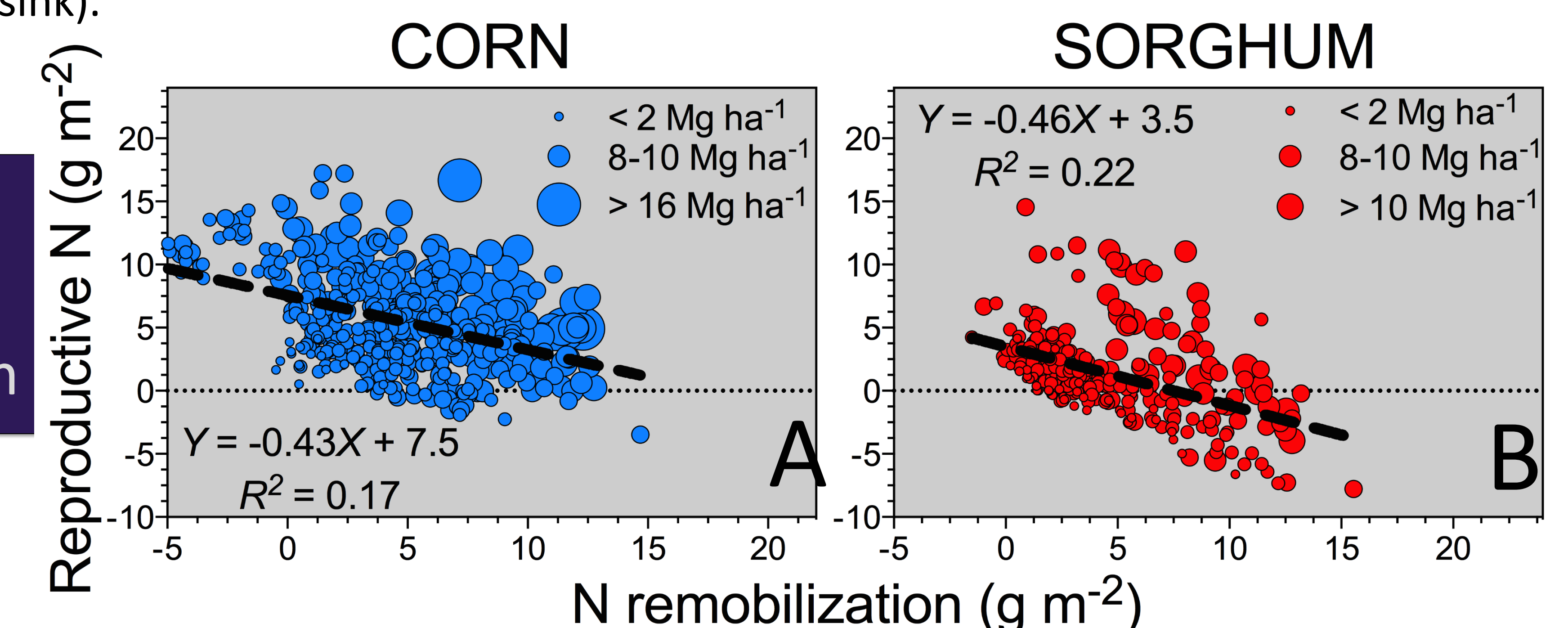


Figure 3. Relationship between Reproductive nitrogen (N) and N Remobilization for corn (A) and sorghum (B).

4) At the plant-scale, data adjusted by the specific plant-density value depicted similar slopes for corn and sorghum under low per-plant yield and N uptake values, but N internal efficiency (yield to N uptake slope) increased more than proportional for corn as compared to sorghum as both yield and N uptake increased (Fig. 4).

5) NIE increased as the grain N concentration diminished, following a similar model for both crops (Fig. 5).

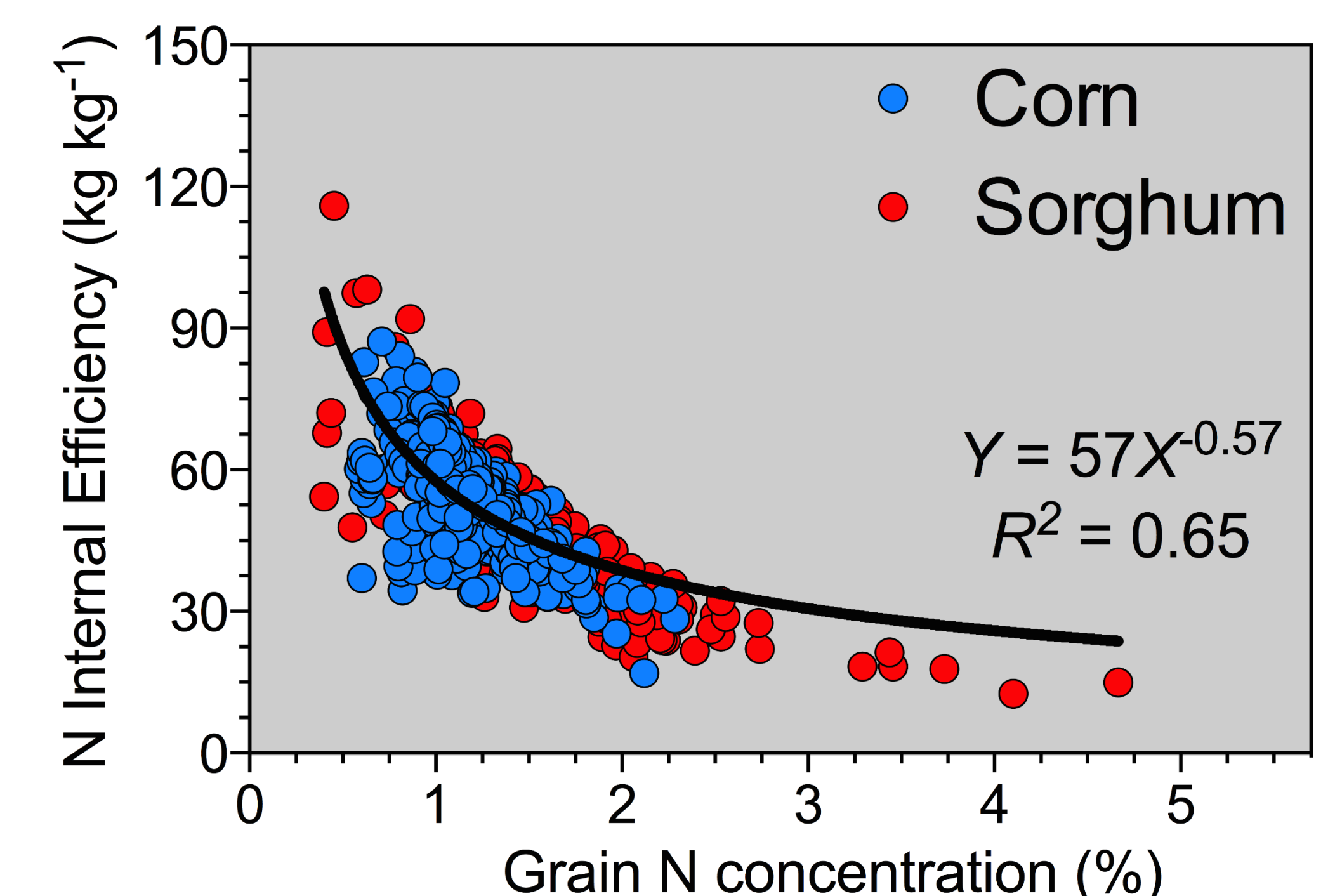
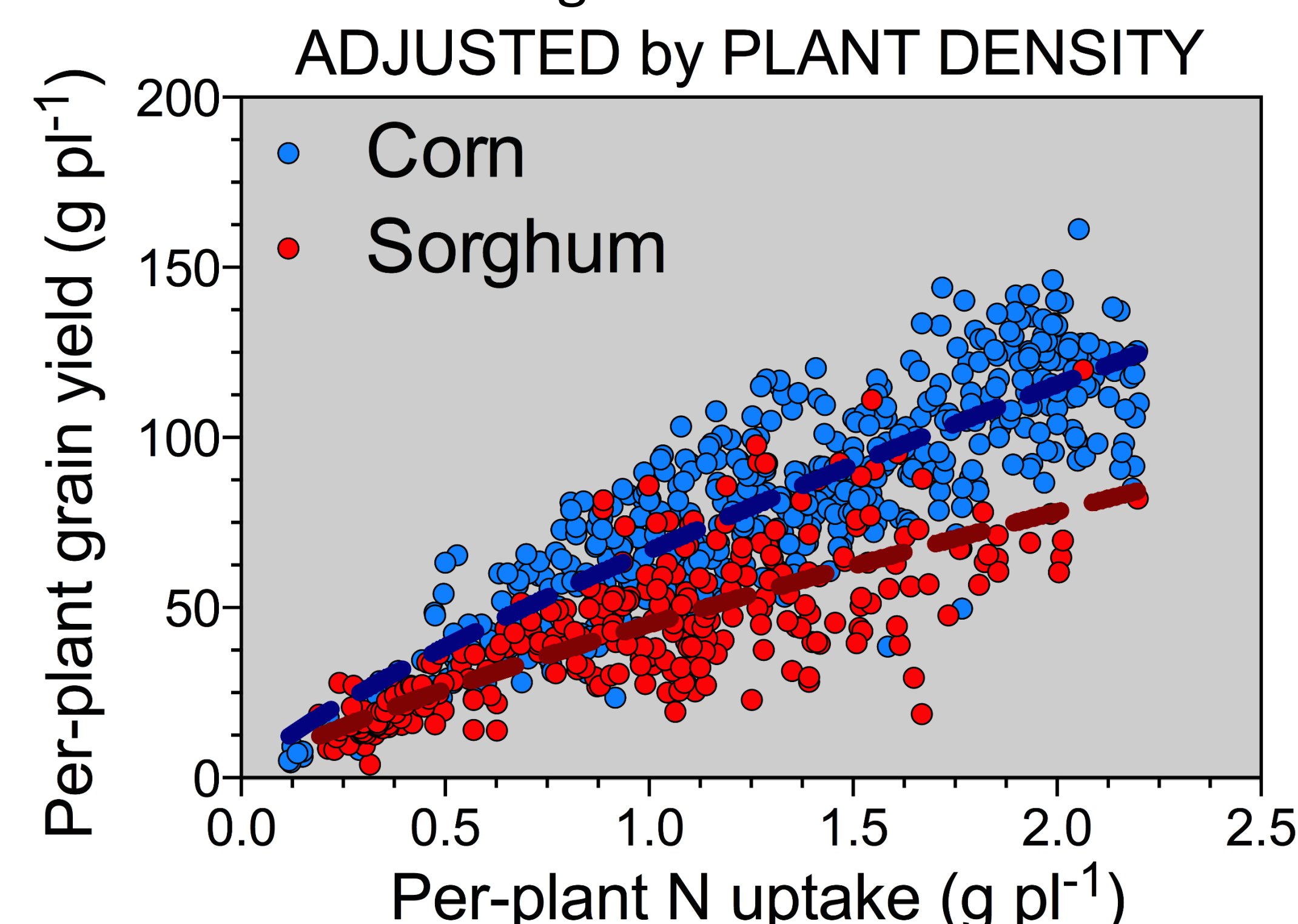


Figure 4. Per-plant grain yield and whole-plant N uptake. **Figure 5.** Nitrogen internal efficiency and grain %N.

Conclusions

For corn, improvements in N uptake and NUE were merely based on yield improvement with lower grain N concentration; while less information is known about sorghum NUE improvement. Thus, the approach of comparing corn and sorghum NUE provides guidance for future improvements in N efficiencies and yield.