Plant Population Influences on Post-silking N Uptake Vary with Hybrid Eras and N Rates

Keru Chen[1], Matthijs Tollenaar[2], Saratha V. Kumudini[2], James J. Camberato[1], Mitchell R.Tuinstra[1] and Tony J. Vyn[1]

[1] Purdue University, Department of Agronomy, [2] The Climate Corporation, Monsanto

Background

The potential for post-silking N uptake (PostN) is constrained by soil available mineral N. However, hybrids and different plant populations also play a critical role in PostN. High plant population alone can significantly decrease PostN, and the negative impact of high plant population can be more severe in a low N fertilizer situation. In addition, newer hybrids, which are generally known to have higher capacity for PostN, might be better able to maintain relatively high PostN compared to older hybrids even at high plant populations.

Objectives (Questions)

- How did a wide range of plant populations affect PostN?
- How did a lower N fertilizer rate exacerbate the reduction of PostN as plant population increased?
- Did newer hybrids (i.e. those first grown commercially in 2005) maintain a higher PostN as plant population increased compared to older representative hybrids from the previous four decades?

Methodology

2-year: 2013 and 2014; **2-location**: West Lafayette and Wanatah in Indiana

2 N rates: 55, 220 kg ha$^{-1;}$ **3 Populations**: 5.4; 7.9 and 10.4 plants m^{-2}

8 Hybrids (arranged in descending era order based on initial commercial year): 2005 (DKC61-69), 2005 (DKC61-72), 2003 (RX752), 2003 (RX752RR2), 1996 (RX730), 1984 (DK636), 1975 (XL72AA), 1967 (XL45)

Biomass sampling: R1 (silking) and R6 (Maturity)

Statistics: Split Split-plot design – N rate is main effect, population is sub-effect, hybrid is sub-sub-effect; 'Proc Mixed' (SAS 9.4) – N rates, plant populations, hybrids are treated as fixed effects, year and locations are random effects

Mean Post-silking Biomass Relationships to Population

P1: 5.4 plants m^{-2}; P2: 7.9 plants m^{-2}; P3: 10.4 plants m^{-2}

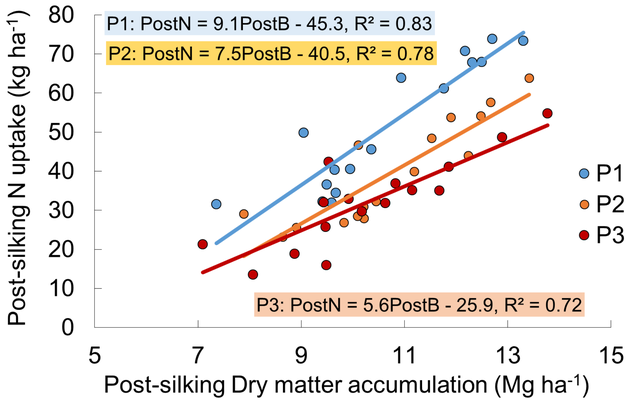

Figure 1. Linear regression between Post-silking N uptake (PostN) vs. post-silking dry matter accumulation (PostB) for 3 densities

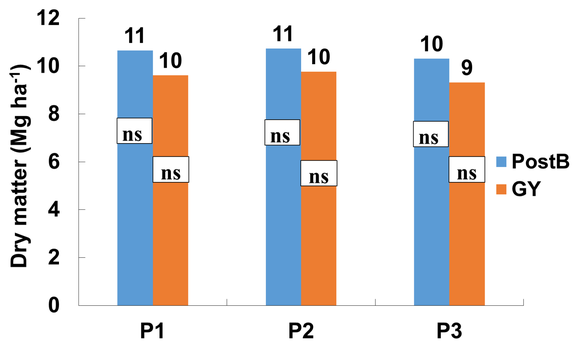

Figure 2. Population as main effect on Post-silking dry matter (PostB) and Grain Yield (GY) at 0% H_2O averaged across 8 hybrids and 2 N rates.

Population, N Rate and Hybrid Effects on Post-silking N

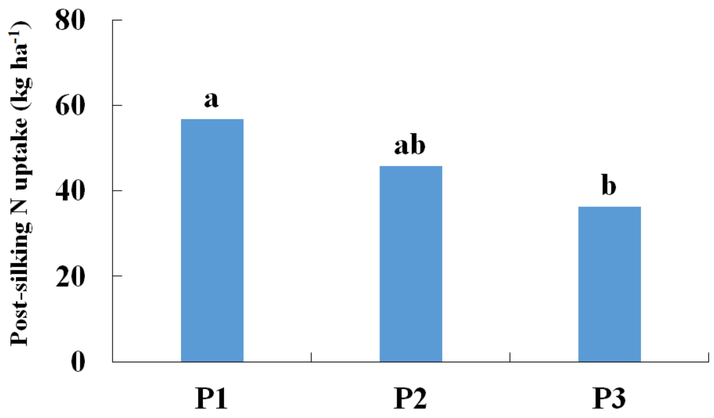

Figure 3. Population as main effect on PostN

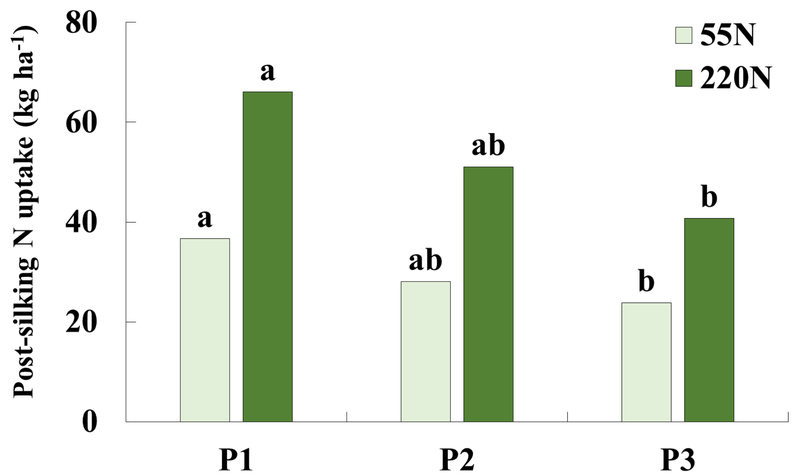

Figure 4. Nitrogen and Population interaction effect on PostN

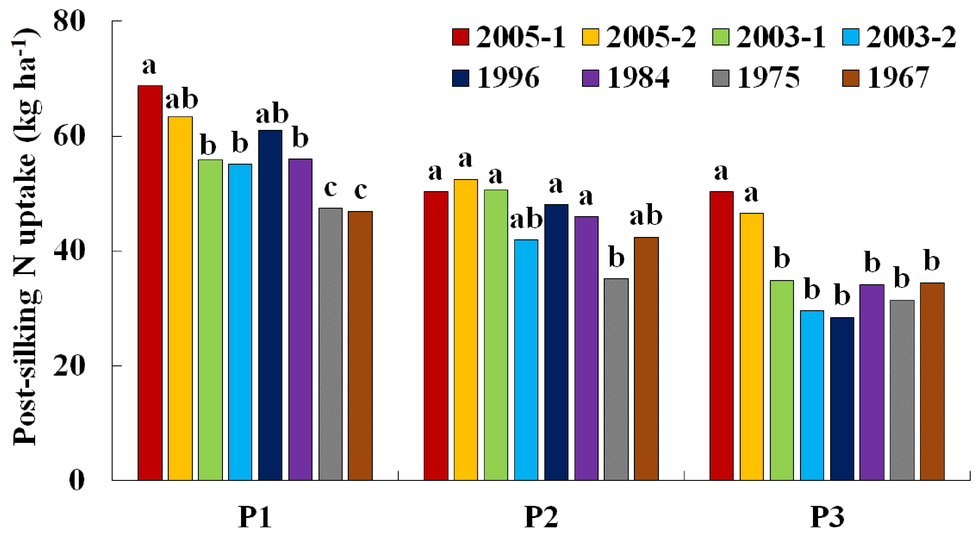

Figure 5. Hybrid and Population interaction effects on PostN

Conclusions

- PostB is the primary driving force for PostN across all population levels, but more PostN was accumulated per unit PostB gain at low densities (Figure 1);
- Population levels did not affect PostB or GY averages, although mean PostB exceeded GY across all populations (Figure 2);
- Higher populations decreased PostN when averaged across all hybrid and N rates (Figure 3), and in a consistent manner under low and high N (Figure 4);
- When averaged over 2 N rates, hybrids released in 2005 achieved higher PostN than all other older hybrids at the highest density (P3), and higher PostN relative to 1967 + 1975 hybrids at low density (P1) (Figure 5).