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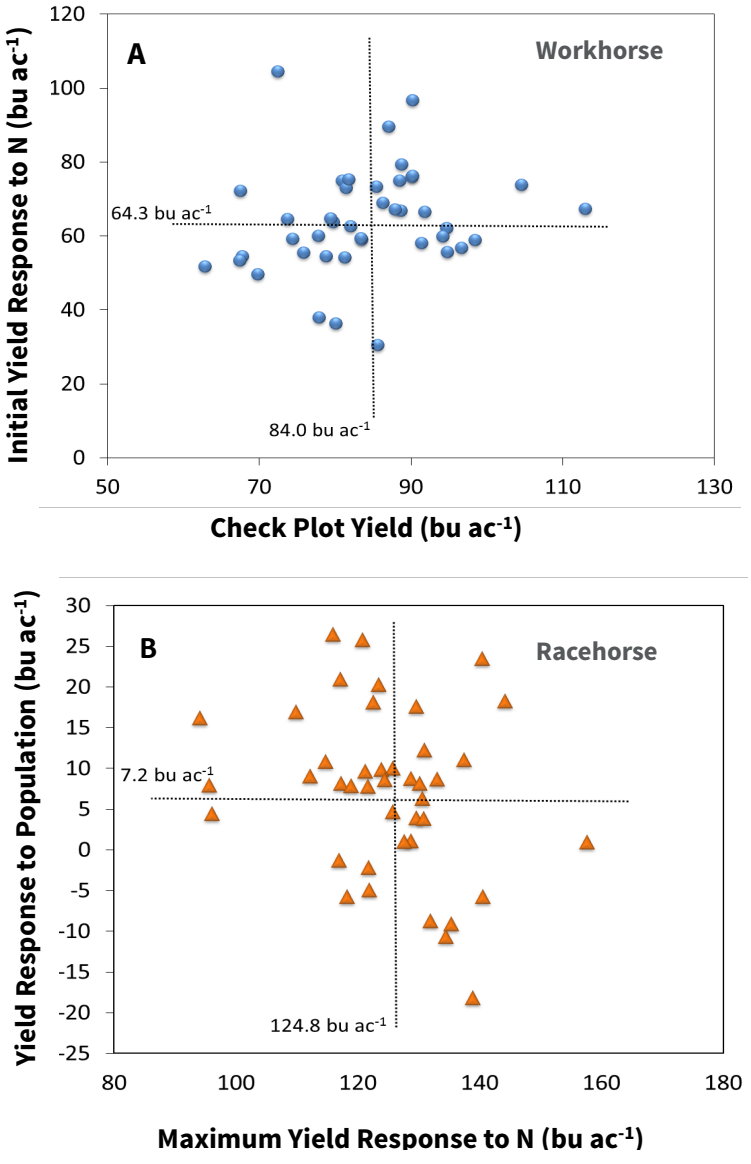
CHARACTERIZING CORN HYBRIDS FOR THEIR RESPONSE TO MANAGEMENT

Hybrid selection, nitrogen (N) fertilizer rate, and plant population are a few of the most important decisions that a farmer must make each growing season. The success of these decisions, however, is difficult to predict since the corn hybrid selected often interacts with the environment and the various crop management practices. Current commercial breeding programs select and develop their corn hybrids under optimum agronomic conditions (high N supply and standard plant densities) and only evaluate a hybrid's responses to different crop management practices at the precommercial stage. The lack of hybrid selection for plant population or N fertilizer responses during the breeding process creates conditions for commercial corn hybrids to have a wide range in yield response to N and plant density. Farmers must consider the agronomic characteristics of each corn hybrid and provide the proper management in order to obtain the greatest yield potential. Unfortunately, there is not much information available for farmers comparing a wide range of commercial corn hybrids in their responses to N fertilizer and plant density.

Over the last couple of years, the Crop Physiology Laboratory has conducted a statewide evaluation of commercial corn hybrids with the goal of understanding inherent differences in their yield responses to management practices. We characterized "racehorse" hybrids as those that are suitable for high yield environments (responsive to crop management) and "workhorse" hybrids as those that can tolerate lower N availability and should thus be stable over a wide range of growing environments. To achieve this characterization,

Figure 27. Relationship between initial N response and check plot (A) and yield response to plant population and maximum N response (B) for 42 commercial hybrids grown at Champaign in 2014. Dashed lines represent the average responses from all hybrids, with average values noted.



hybrids were grown with three levels of fertilizer N (0, 60, and 240 lb N acre-1) combined with two levels of plant density (32,000 and 45,000 plants acre-1).

Important parameters in a hybrid's characterization included its check plot yield (yield with 0 lb N acre-1 at 32,000 plants acre-1), its initial yield response to N (yield change between 0 and 60 lb N acre-1 at 32,000 plants acre-1), its maximum yield response to N (yield change between 0 and 240 lb N acre-1 at 32,000 plants acre-1), and its response to plant population (yield change between 32,000 and 45,000 plants acre-1 at 240 lb N acre-1). We observed a large degree of variability among these commercial corn hybrids in all of the measured traits (Figure 27), which emphasizes the importance of hybrid characterization under different N fertility and plant density conditions. Hybrids with above-average check plot yield and high initial N response, represented in the orange quadrant of Figure 27A, were considered workhorse types, which we expect would yield well under conditions associated with lower N availability (i.e., lower rates of N fertilizer application and/or weather conditions leading to N loss). Similarly, hybrids that exhibited above-average yield for plant population and maximum yield response to N, represented in the blue quadrant of Figure 27B, were considered to be racehorse types, which we expect would yield well with intensive management and good growing environments.

To characterize racehorse and workhorse hybrids, we ranked each hybrid from 1 to 10 (based on the trial average) to generate a score for each of the measured parameters. The summation of check plot yield and the initial response to N scores constitutes the "workhorse index," and the combination of maximum response to nitrogen and response to population scores constitutes the "racehorse index" (where in both indices, 2 = lowest and 20 = highest).

SUMMARY

Typical variety testing methods using "standard" agronomic conditions (240 lb N acre-1 at 32,000 plants acre-1) may be useful in determining a hybrid's yield potential, but they do not provide information regarding a hybrid's tolerance to N deficiency or its response to sufficient levels of N or to increased plant population. An example of this characterization is shown in Figure 28. Note that hybrids can exhibit similar yield under standard agronomic conditions but vary in their yield responses under conditions conducive to N loss or under management practices conducive to high yield. Characterizing hybrids with these workhorse and racehorse indices can help producers and agricultural professionals better match hybrids and crop management styles according to their potential yield responses.

Figure 28. Grain yields and hybrid rankings under standard agronomic conditions (240 lbs N acre-1 at 32,000 plants acre-1) and the calculated workhorse and racehorse indices based on the hybrid evaluation of the check plot yield, initial response to N, maximum response to N, and response to plant population for 10 commercial corn hybrids evaluated at Champaign, IL, in 2014.

Yield rank	Yield (bu ac^{-1})	Workhorse index	Racehorse index
1	243	14.0	11.7
2	235	8.3	15.0
3	233	10.8	14.0
4	233	14.0	13.8
5	233	9.0	11.5
6	231	14.3	12.8
7	231	15.8	15.3
8	228	10.0	13.5
9	226	13.5	12.8
10	225	14.5	13.8
LSD (P ≤ 0.10)	28.4	3.2	3.7