FLORIDA

Starter Fertilizer: Nitrogen, Phosphorus, Corn Hybrid Response, and Root Mass

By Fred Rhoads and David Wright

In a greenhouse experiment, this study showed that a hybrid failing to respond to starter fertilizer, containing nitrogen (N) and phosphorus (P) under field conditions, produced a larger root system than one consistently producing a positive response. If starter response under field conditions is due to only one element (N or P) because the other is supplied in adequate amount from the soil, then it is not known whether each hybrid responds in the same manner to the other element. This report shows response of each hybrid to starter N and P varied independently of each other.

Not all corn hybrids show a positive grain yield response to starter fertilizer. Both N and P are considered essential ingredients in starter fertilizers to offset low N and P availability in cold soils. Characteristics of corn that influence response to starter fertilizer include rate of top and root growth, N and P uptake efficiency, and growth response to temperature. A hybrid having a high rate of root growth and uptake of N and P is expected to show little or no response to starter fertilizer compared to broadcast application. Therefore, a positive response to starter fertilizer is expected of a hybrid having a slow rate of root growth and/or low nutrient uptake rate.

Corn hybrids, 'Deltapine G4733' and 'Northrup King 508', were selected for greenhouse experiments because Deltapine G4733 consistently gave a highly positive grain yield response to starter fertilizer and NK508 consistently failed to respond in a starter fertilizer field experiment at NFREC, Quincy, Florida. The hybrids were seeded in pots containing 2 kg of soil...with low P, less than 15 parts per million (ppm) of Mehlich-1 P...from the A horizon of Norfolk loamy fine sand (fine loamy, siliceous, thermic, Typic Kandiudult) on March 17 in a glasshouse at Quincy. Six seeds were planted in each pot (1.5 liter soil volume), and plants were thinned to two per pot at the two-leaf stage.

In this experiment, N rate was 200 mg per pot (about 200 lb/A) and P rate was 273 mg P_2O_5 per pot (about 273 lb/A) for all treatments mixed with total soil volume (broadcast) or banded 2 inches below the surface and 2 inches horizontally from seed. Nitrogen was banded with P, broadcast with P, and banded alone. There were three treatments for each of the two hybrids. The source of K for this experiment was K_2SO_4 at 415 mg pot (about 415 lb/A) mixed with total volume of soil.

The experiment was harvested 41 days after seeding. Average minimum temperature was 52ºF while average maximum temperature was 75.5ºF. Roots were separated from the soil by screening and washing with tap water. Yield of both tops and roots was deter-

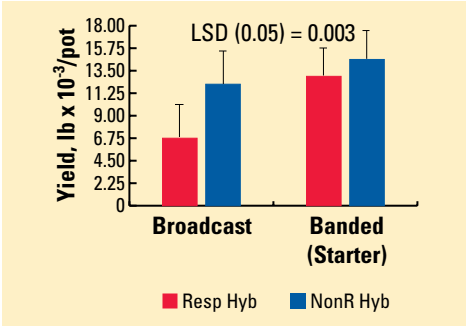

Figure 1. Corn hybrid top growth with broadcast vs. banded N.

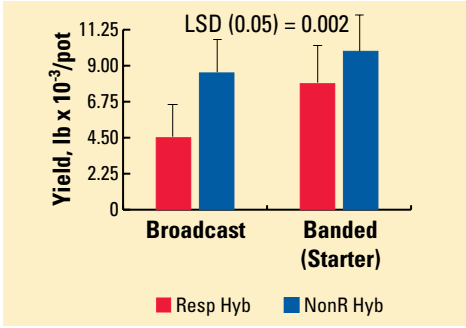

Figure 2. Corn hybrid root growth with broadcast vs. banded N.

mined after drying to constant weights at 160ºF.

The nonresponsive hybrid (NK508) from the field experiment did not respond to starter N with increased top or root growth as shown by error bars representing the least significant difference (LSD) in **Figures 1** and **2**. However, the responsive hybrid (G4733) responded to starter N with both increased top and root growth. But root growth of the nonresponsive hybrid was greater than that of the responsive hybrid with either broadcast or banded N. Banding N does not influence absorption by the root system by increasing solubility or mobility. Rather, it allows access to much greater amounts of N in a much smaller root volume. This study suggests that where mixing nutrients with the entire soil volume does not reduce solubility or mobility, hybrids with most rapidly expanding root systems are less likely to respond to band placement of nutrients or starter fertilizer.

Response to starter P was similar between hybrids (**Figures 3** and **4**) as measured from top and root growth. There was no difference between hybrids in top growth with broadcast P (**Figure 3**). However, top growth increased 78 percent in the nonresponsive hybrid and only 62 percent in the responsive hybrid due to starter P. Root mass was always greater for the nonresponsive hybrid, which supports the hypothesis that nonresponsive hybrids should have greater root mass. But root mass does not explain why both hybrids responded to starter P.

In soils that fix or immobilize P, most

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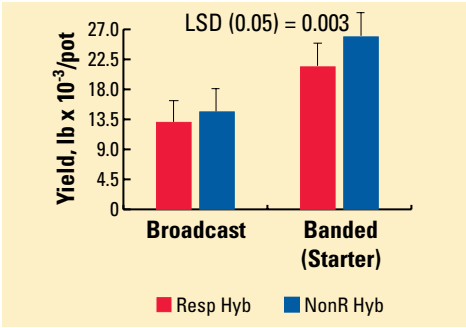

Figure 3. Corn hybrid top growth with broadcast vs. banded P.

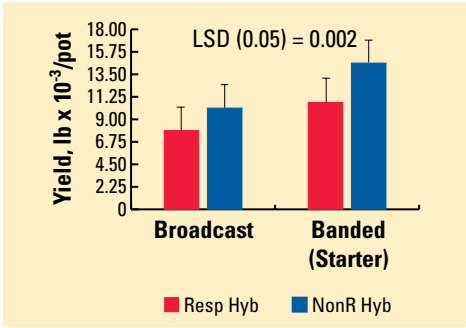

Figure 4. Corn hybrid root growth with broadcast vs. banded P.

The VR application resulted in a $11/A saving in fertilizers. The marketable yield of the VR treatment was not different from the CR treatment, but was much larger than in the control treatment (CT), (**Figure 2**). The VR also had equivalent yields to CR for different tuber categories: Canada #1 small, Canada #1 and Canada #1 large. However, the VR had higher N and P concentrations but less K than in CR. Calculations of the compositional nutrient diagnostic (CND) index showed that VR had the best nutrient equilibrium among treatments and that K was the most yield limiting nutrient at this site. The VR application increased the uniformity of soil test levels sampled at harvest. In 1997, the marketable potato yield was 30 cwt/A greater in the VR than in the CR treatment (**Figure 2**).

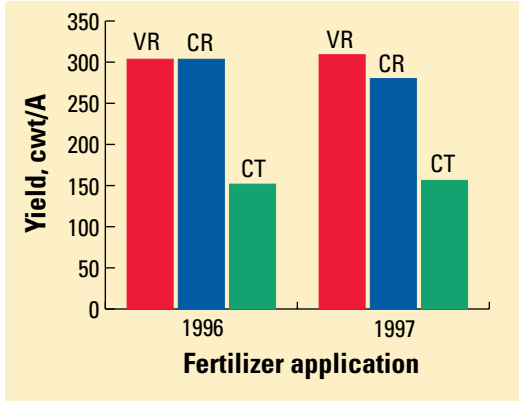

Figure 2. Marketable yield of potato as affected by variable rate (VR), constant rate (CR) or control (CT) fertilizer application.

At this site, variable rate application of P and K gave potato yields equal to or greater than those with constant rate. Potassium was the most limiting nutrient. The fertilizer savings the first year were almost equal to the commercial cost of mapping the site. The agronomic and economic benefits of precision fertilizer application in potato production are very encouraging. .BC

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of the broadcast P is not available to corn seedling roots because of the intimate contact between soil and P, while banding P minimizes fixation and immobilization by reducing P and soil contact. Therefore, size of root system is not important when the band is near the seed under these circumstances. However, at warm temperatures in soils with high residual P or those that do not fix P, hybrids with larger root systems may not respond to starter P. In cold soils, hybrids with larger root systems may respond to starter N as well as P because root growth of all hybrids is reduced by low temperature.BC

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