No-till Grain Sorghum Responds to Starter Nitrogen-Phosphorus Combinations

By W. B. Gordon and David A. Whitney

Kansas studies emphasize the importance of starter fertilizers containing nitrogen (N) and phosphorus (P) in no-till grain sorghum. Higher N relative to P in the starter resulted in greater crop response than conventional 1:3 ratios of N:P_2O_5.

MAINTAINING ground cover from crop residues to control soil erosion is an important factor in crop production in the central Great Plains. No-till production systems are effective in maintaining those surface residues. But, early-season plant growth and yield are often poorer in no-till than in conventional systems. The large amount of surface residues in no-till systems can reduce seed-zone temperatures and hamper plant nutrient uptake. However, starter fertilizers can place nutrients within the rooting zone of seedlings for improved nutrient availability, better uptake and improved early season growth.

Some experiments that have evaluated crop response to N-P starter fertilizers have demonstrated improved early growth and increased yield and attributed those responses to the P component of the combination. Other studies have indicated that N is the most critical element in the N-P starter fertilizer on soils not low in P.

Some grain sorghum producers in the Great Plains prefer to delay planting until mid-June in order to avoid drought and heat stress in July during the reproductive phase of crop development. However, late planting increases the risk of an early frost before the crop is mature. Use of starter fertilizer can hasten maturity and avoid late-season, low temperature damage. Planting sorghum early to produce heading prior to mid-season heat and moisture stress is hindered by sorghum's slow emergence and growth in cool soils. Starter fertilizer can be useful in improving early-season growth in cool soils.

Little information is available on the response of grain sorghum to N-P_2O_5 combinations (ratios) in starter fertilizers. This study was designed to evaluate no-till grain sorghum response to several N-P_2O_5 starter fertilizer combinations at two planting dates.

Kansas Study

This field experiment was conducted at the North-Central Kansas Experiment Field near Belleville, KS, on a Crete silt loam soil for three crop years, 1991-1993. Initial soil test values were high, 24 parts per million (ppm) Bray-1 P and 380 ppm exchangeable K. Treatments consisted of mid-May and late June planting dates and N-P_2O_5 liquid starter fertilizer combinations to supply 0, 10, 30 or 90 lb N/A with or without 30 lb P_2O_5/A. A surface broadcast treatment consisting of 90 lb N and 30 lb P_2O_5/A (no-starter check) was also included. Starter fertilizer treatments were knife-applied at planting 2 inches to the side and 2 inches below the seed. Immediately after planting, surface broadcast applications brought the total amount of nutrients applied to 90 lb N and 30 lb P_2O_5/A.

Results

No interactions between planting date and starter fertilizer combinations were noted, but earlier planting did signifi-

Dr. Gordon is Agronomist, North-Central Kansas Experiment Fields, Courtland, KS and Dr. Whitney is Agronomy Extension Leader, Kansas State University, Manhattan, KS.

Table 1. Planting date and starter fertilizer effects on 6-leaf stage dry matter and P uptake, days from emergence to mid-bloom, and yield of no-till grain sorghum.

Treatment, lb/A Starter N	P_2O_5	Yield, bu/A	Days to mid-bloom	6-leaf stage Dry matter, lb/A	6-leaf stage P Uptake, lb/A
10	30	91	65	587	2.2
30	30	101	59	677	2.6
90	30	101	59	701	2.7
90	0	87	66	591	2.0
30	0	87	66	575	2.0
0	30	88	67	580	2.0
90	30 Broadcast	83	66	556	2.0
Planting Date					
May		108	68	637	2.4
June		74	60	581	2.0

cantly increase yields. Starter responses were recorded for both the early and late planting dates.

Averaged over the three years, starters that supplied either 30 or 90 lb N/A with 30 lb P_2O_5/A (1:1 and 3:1 N:P_2O_5 ratios) both increased yields by 18 bu/A over the no starter check (**Table 1**). At current market prices, that response represents increased revenue of over $33/A. Application of 10 lb N/A with 30 lb P_2O_5/A (1:3 N:P_2O_5 ratio) also increased yields over the no starter check but was not as effective as the 1:1 or 3:1 ratios. Nitrogen or P applied alone did not result in any yield increase over the no starter check.

When compared to the check, the 1:1 and 3:1 N:P_2O_5 starter ratios shortened the period from emergence to mid-bloom by 7 days. None of the other starter combinations produced this affect.

Only the 1:1 and 3:1 N:P_2O_5 ratio treatments significantly increased early-season dry matter production and P uptake (6-leaf stage) compared to the no starter check.

Summary

Use of starter fertilizer significantly improved early-season growth, P uptake and yield of early and late-planted no-till grain sorghum even when soil test P was adequate. However, the traditional N:P_2O_5 ratio of 1:3 (10 lb N and 30 lb P_2O_5/A) was not as effective as a 1:1 (30 lb N and 30 lb P_2O_5/A) or a 3:1 (90 lb N and 30 lb P_2O_5/A) ratio. The 1:1 and 3:1 N:P_2O_5 ratio starters increased grain yields 22 percent over the no starter check. This study emphasizes the importance of starter fertilizers with higher N:P_2O_5 ratios in no-till sorghum production. ■

NO-TILL grain sorghum responses to starter N and P are dramatic. Plants on the left received high N:P_2O_5 ratio starter applications which enhanced both early growth and grain yields.