Dr. Dan Sweeney

# Nutrient Placement Affects Yield In Grain Sorghum

## Kansas scientist compares sorghum responses to broadcast, dribble, and knifing of NPK suspension fertilizers in two-year placement study.

***Summary:*** *Knifing produced higher yields than broadcast or dribble applications. Even though knifing tended to increase yields in all tillage systems, placement was more important in the no-till system. Knifing increased amounts and rates of N, P, and K uptakes early in the season and appeared to shorten the time to reach maximum plant growth and P and K uptakes. Positional availability of knifed plant nutrients early in the growing season, especially P and K, may improve nutrient uptake by grain sorghum and also affect kernel potential that is determined shortly after growing point differentiation and, consequently, yield.*

Public awareness for the environment, farm programs, and economic concerns has increased the amount of U.S. land planted in conservation tillage. With less soil mixing, placement of fertilizer becomes more important. Research has shown that fertilizer placement can affect yields in conservation tillage systems. Surface or subsurface banding has resulted in greater nutrient-use efficiency than broadcast application.

The objective of this two-year study was to determine the effect of broadcast, surface band (dribble), and subsurface band (knife) placements of N, P, and K suspensions on grain sorghum yield, dry matter production and nutrient uptake in conservation tillage systems.

### Yield components

*Tillage*. Grain sorghum yield was not significantly affected by tillage system in either year.

*Placement*. Suspension fertilizer applications increased two-year average yields over the check by nearly 20 bu/A, regardless of placement method (Figure 1). Method of placement also significantly affected yields. Knifing produced higher yields than broadcast or dribble applications. Even though knifing tended to increase yields in all tillage systems, placement was more important in the no-till system.

*Split N* applications did not increase yields. However, in the first year of the study, a knife/split-N application tended to result in the highest yields (data not shown).

*Kernels per head* were affected by suspension application methods (Figure 2) and paralleled yield responses. These data suggest that placement methods affected the sorghum plants early in the growing season because the potential number of kernels per head is determined shortly after growing point differentiation. Plant stand was minimally affected by placement, as also shown in Figure 2.

### Growth and uptake

*Tillage*. Although no-till resulted in nearly a 30 percent decrease in dry matter accumulation and N, P, and K uptakes at the nine-leaf growth stage when compared with either reduced or ridge-till, further reductions at later growth stages were generally not

significant (data not shown). In addition, split N applications or the interactions between tillage, method, and split N application had minimal effects on growth or nutrient uptake at the three measured growth stages.

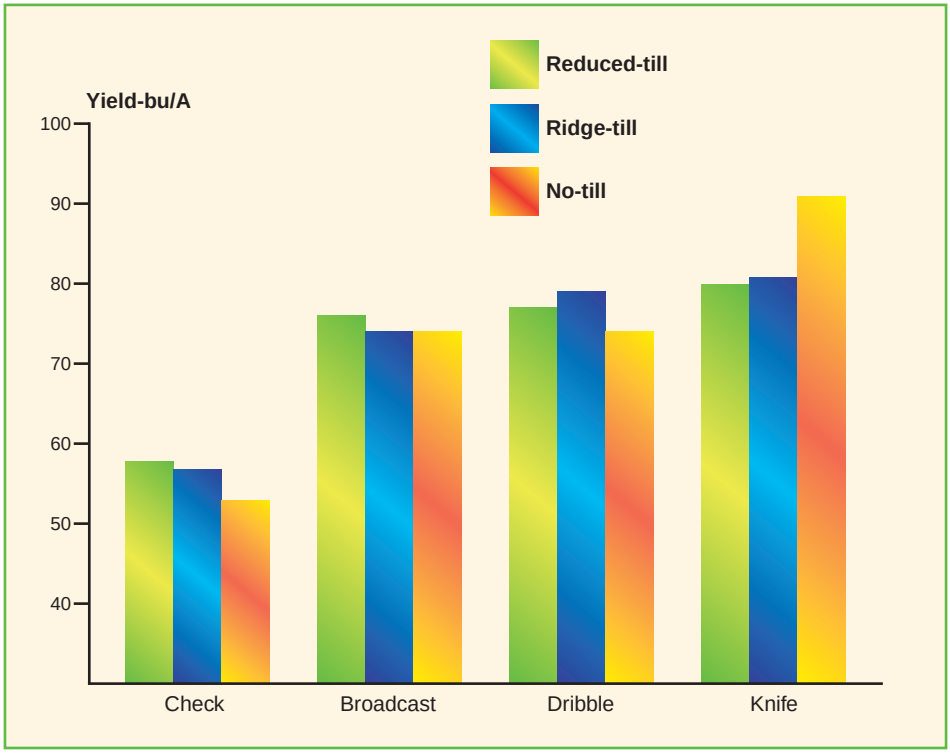


Figure 1. Grain sorghum yield response to tillage and suspension fertilizer application methods, two-year average, Sweeney, Kansas State University.

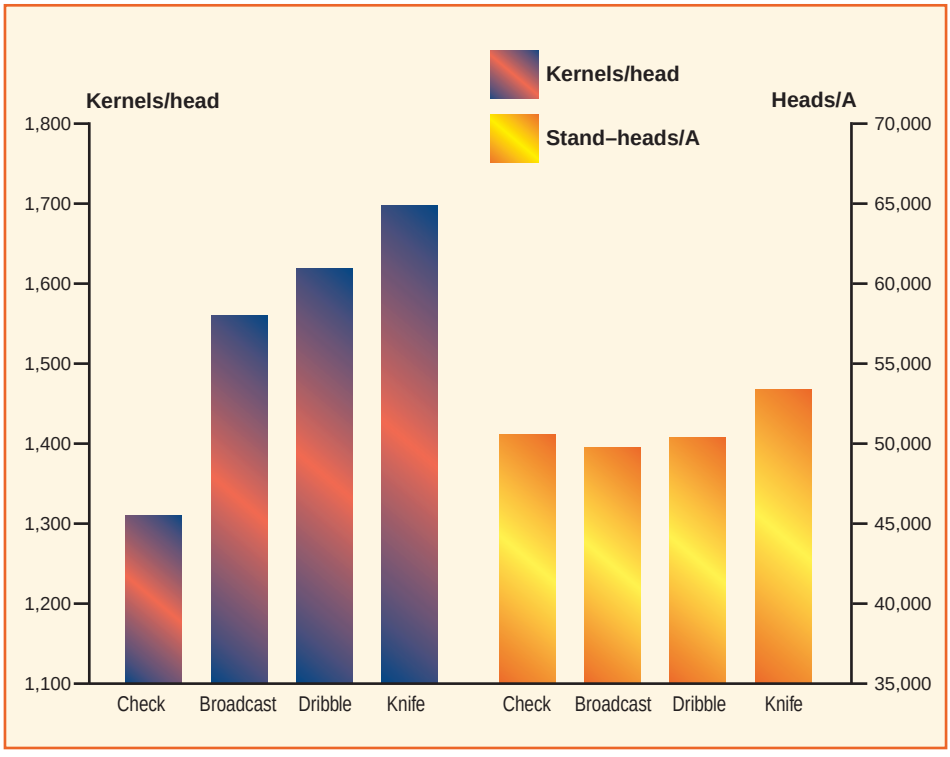


Figure 2. Grain sorghum yield component responses to suspension fertilizer application methods, Sweeney, Kansas State University.

*Placement*. The highly significant and uniformly consistent response to fertilizer treatments was due to placement method and to fertilization in general. Dry matter accumulation from the nine-leaf to soft dough stage of growth suggested that the plants grew slowly at first and then more rapidly to soft dough (data not shown). At the nine-leaf stage, knife placement of the NPK suspension resulted in greater dry matter than either surface placement or the check. This difference became more pronounced during the season. Growth rates with surface placement methods did not appear to reach a maximum until 88 days after planting (Figure 3). However, knife placement appeared to result in maximum growth rate by 74 days after planting.

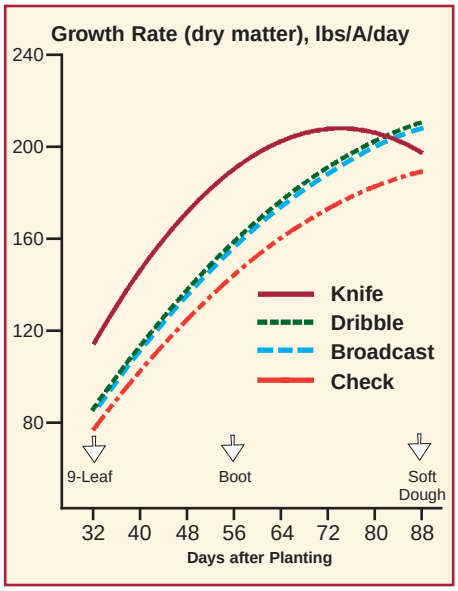


Figure 3. Rate of sorghum dry matter accumulation in response to NPK suspension application methods, Sweeney, Kansas State University.

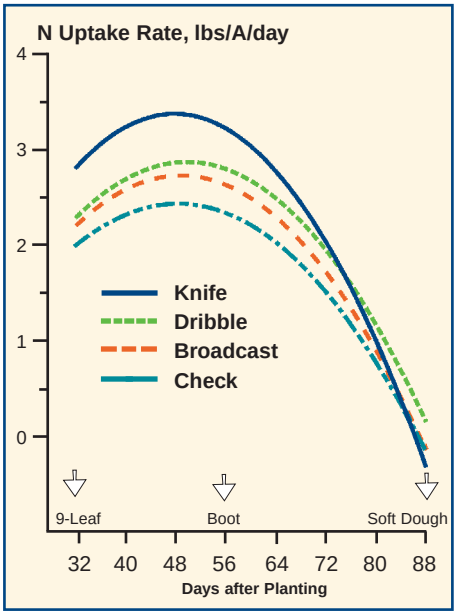


Figure 4. Rate of N uptake in response to NPK suspension placement, Sweeney, Kansas State University.

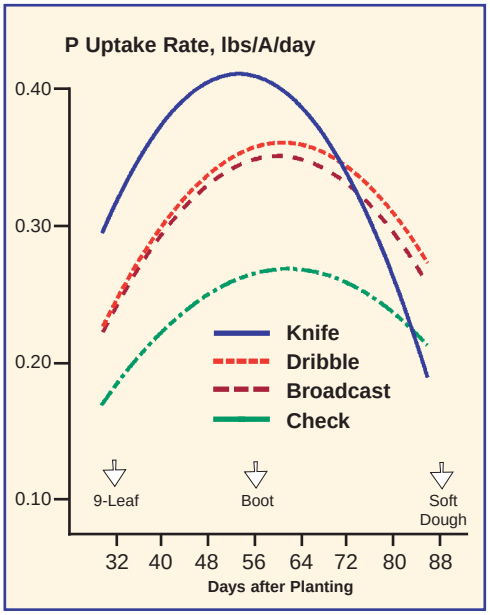


Figure 5. Rate of P uptake in response to NPK suspension placement, Sweeney, Kansas State University.

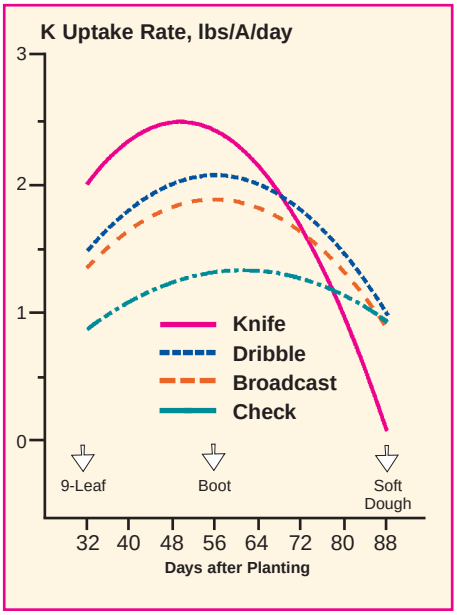


Figure 6. Rate of K uptake in response to NPK suspension placement, Sweeney, Kansas State University.

Cumulative N, P, and K uptakes by grain sorghum followed a general sigmoid pattern with time (data not shown). Maximum rate of N uptake with knifing was approximately 1 lb/A/day more than uptakes for the check, and 0.5 lb/A/day more than uptake for the two surface placement methods (Figure 4). Maximum N uptake occurred near 49 days after planting for all placement treatments.

Maximum rate of P uptake with knifing was approximately 15 percent greater than either broadcast or dribble placement and 50 percent greater than the check (Figure 5). Maximum P uptake rate occurred 56 days after planting for knifing but approximately one week later for the check and surface placement. This shift may be explained partially by differences in maturity.

Potassium uptake followed the same sigmoid patterns as N and P uptakes (data not shown). Maximum K uptake with knifing was nearly double the maximum rate for the check (Figure 6). Even though K uptake was less than with knifing, surface applications increased the maximum K uptake rate by 50 percent above that of the check. Maximum uptake with knifing was approximately 49 days after planting, which was one week earlier than that for either surface placement and two weeks earlier than that for the check. The effect of placement on the date of maximum K uptake cannot be explained entirely by a shift in maturity.

**Profile**

*Soil* was a Parsons silt loam, a typical claypan soil of southeastern Kansas, testing low in available P and K, with a relatively high organic matter content.

*Cultivation*. Dribble and knife spacings were 30 inches. Knife depth was 4 inches.

*N timing*. N was applied half at preplant and half at the nine-leaf stage as a dribbled sidedress.

*Fertilizer*. Preplant N, P, and K were applied as a suspension. Later N applications used UAN. Total fertilization rate was 150-100-150 (lbs/A of N-$P_2O_5$-$K_2O$).

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