FERTILIZER MANAGEMENT OF MONOCROPPED SOYBEANS IN REDUCED TILLAGE SYSTEMS

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Introduction

Placement of P and K fertilizers in reduced tillage systems for soybeans has recently received much attention in the farm and agricultural research press. The resource-conserving advantages associated with reduced tillage systems are accompanied by a number of management difficulties, one of which is poor vertical fertilizer distribution. Because P and K fertilizers are relatively immobile in most soils, broadcast applications of these nutrients under no-till management leads to accumulation of P and K in the top few inches of soil (Whitney, 1982; Bakermans and Wit, 1970). Surface accumulation of P and K may result in "positional unavailability" because uptake by roots in the surface can be inhibited by soil drying and herbicides. This problem, and the need to evaluate fertilizer rates and placement in conservation tillage systems, has recently received national recognition (Quinn et al., 1984).

Suggested methods for overcoming this problem include placing starter fertilizer in the bottom of an in-row subsoil track (Martin and Touchton, 1983), deep injection of liquid P and K, banding and dribbling strip applications of P and K on the soil surface, and tillage rotations. In general, it has been shown that deep placement of fertilizer results in more efficient use of applied nutrients (Batchelor, 1983), but relatively little data exists for methods of P and K placement in no-till soybeans. Thus the objective of this work was to evaluate P and K applied by liquid injection or surface broadcast in conventionally tilled and no-till soybeans.

Materials and Methods

'Centennial' soybeans were planted on a Memphis silt loam at Raymond, MS, an Okolona silty clay at Brooksville, MS, and a Leeper silty clay loam at Mississippi State University (MSU) in 1983. Each experiment was a split-split plot design. The treatments at the Raymond and Brooksville locations were tillage (conventional chisel plow vs. no-till), method of fertilizer placement (injected vs. broadcast), and fertilizer rates (0-0-0, 0-30-45, 0-90-135 lbs/a). Each treatment was replicated five times. At MSU, treatments included tillage (conventional vs. no-till), row placement (in or between the previous year's rows), and fertilizer placement (injected vs. broadcast 0-90-135). Each treatment was replicated four times.

The liquid fertilizer used was a mixture of K_2HPO_4 and KC1 and was injected 8" deep and 4" to the side of the row. Initial soil test values were low to medium for P and K at Brooksville and Raymond, while both P and K tested high at MSU.

Results and Discussion

Soybean yields for the MSU location are seen in Table 1. There was no significant yield difference between broadcast and injected fertilizer treatments in either no-till or conventionally tilled plots when soybeans were planted in the old rows. When beans were planted between the old rows, broadcast P and K resulted in significant yield increases in the conventionally tilled plots while injected P and K increased yields in the no-till treatments.

On the Blackbelt soil at Brooksville, there was no significant response to injection in either tillage system (Table 2). On the Brown Loam soil at Raymond, injection resulted in a significant yield increase over broadcast P and K in no-till plots, but no difference was observed in conventionally tilled beans. At both locations, increasing rates of broadcasted P and K in no-till treatments caused a slight yield decrease that was not observed in injected plots. The first year of the tillage rotation (3 times the annual fertilizer rate with deep incorporation) resulted in significantly higher yields relative to broadcast no-till plots.

Results at these three locations indicates that liquid injection of P and K can overcome positional availability problems in no-till soybeans, and are similar to those results of Martin and Touchton (1983), who noted positive responses to deep placement of P and K in double cropped soybeans. Because yields of no-till soybeans in heavy textured soils are usually lower than conventional-tilled beans (Sanford et al., 1983) this management practice may hold promise for the future.

Row Placement	Method of fertilizer application	Tillage Conventional	Tillage No-till
Planted in old rows	Broadcast	32.3 (A)	32.4 (A)
	Injected	31.3 (A)	34.8 (A)
Planted between old rows	Broadcast	36.9 (B)	32.4 (A)
	Injected	32.2 (A)	36.2 (B)

Table 1. Soybean yields (bu/a) as a function of tillage, method of fertilizer application, and row placement on a Leeper silty clay loam at MSU, 1983. Yields followed by the same letter do not differ at the 0.05 level of significance (DMRT valid for comparison of broadcast and injected pairs only.)

	Annual rate of P_2O_5 (lbs/a)	Method of Fertilizer Application: Broadcast	Inject	3 x Annual rate:deep incorporation
No-Till	0	19.2	19.5	20.1
Okolona silty clay	30	18.2	18.0	23.9
Brooksville, MS	90	16.4	20.2	22.4
	Means	18.0(B)	19.2 (AB)	22.1 (A)
Conventional tillage	0	19.9	16.4	23.4
Okolona silty clay	30	20.9	19.1	22.9
Brooksville, MS	90	21.7	20.0	22.6
	Means	20.9(AB)	18.5(B)	23.0(A)
No-Till	0	12.0	16.7	23.8
Memphis silt loam	30	10.2	14.1	23.8
Raymond, MS	90	8.6	16.2	22.1
	Means	10.3(C)	15.7(B)	23.2 (A)
Conventional tillage	0	20.4	20.7	21.3
Memphis silt loam	30	19.6	18.8	20.3
Raymond, MS	90	19.9	20.9	20.7
	Means	19.9(A)	20.1 (A)	20.8(A)

Table 2: Sovbean Yields (bu/a) as a function of tillaqe, method of fertilizer application, and rate of fertilizer application on Blackbelt and Brown Loam loess soils in Mississippi, 1983. Yields and means in each row followed by the same letter do not differ at the 0.05 level of significance (DMRT).

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