FERTILIZER AND LIME PROBLEMS IN UPPER SOUTH

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Surface application of lime, phosphorus and potassium in continuous no-tillage systems has prompted many questions. Can surface-applied unincorporated lime adequately neutralize soil acidity? Will phosphorus and potassium move into the soil enough to supply adequate plant nutrition? Research has shown that under many no-tillage conditions, the burial of lime, phosphorus, and potassium is an unnecessary undertaking (Singh et al., 1966; Shear and Hoschler, 1969; Triplett and Van Doren, 1969; Moschler et al., 1972; Fink and Wesley, 1974; Kang and Yunusa, 1977; Blevins et al., 1978). However, research on fertilizer placement on low testing soils is continuing. In Tennessee, research is being conducted at Milan comparing N, P and K at various rates and placements including surface broadcast, banding, and injection. Placement and fertilizer for no-till soybeans is also being studied. The placement of P and K may turn out to be of much less importance as compared to methods of applying certain forms of nitrogen in no-tillage systems.

Under certain conditions, gaseous losses of nitrogen from surface-applied ammonium salts, and urea have been large (Terman and Hunt, 1964; Hargrove et al., 1977; Fox and Hoffman, 1981; Bandel et al., 1980). This is illustrated by research results shown in Figure 1 (Charles R. Graves and Donald D. Howard of the Plant and Soil Science Dept., Univ. of Tenn.). A comparison of unincorporated urea and ammonium nitrate at three rates was studied in conventional and no-tillage corn. As shown in Figure 1, 1981 yields in conventional-tillage were significantly lower at the 120 and 160 lbs N/acre rates when urea was the source as compared to ammonium nitrate. In no-tillage the yield differences between sources were much larger and significant at all nitrogen rates. Based on yield response the surface application of urea on the no-tillage wheat residue resulted in much larger losses than the surface application on a conventionally prepared seedbed. After fertilizer application no significant rain occurred for 6 days. As shown in Figure 2, yield differences were much smaller and not significantly different in 1982. However, there was a trend for N source differences to be larger in no-tillage than with conventional-tillage. In this season rainfall occurred within 3 days after fertilization. Volatilization losses of N from urea are minimized if it is soil incorporated. Banding and injection have been beneficial in reducing losses (Mengel et al., 1982; Touchton and Hargrove, 1982). These methods for reducing losses are being investigated in Tennessee.

Nitrogen can also be lost in other ways. Leaching (movement into the soil below the root zone), denitrification (conversion to a gas usually associated with excessively wet conditions), and immobilization (the tie-up of nitrogen in organic matter decomposition processes) are also avenues of nitrogen loss. One way of avoiding these losses is delaying application until the plant is growing and more ready to utilize the nitrogen. With most row crops very little

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nitrogen is used in the first 4 to 6 weeks. This is true for corn. Nitrogen application at corn planting in April and May in Tennessee can be followed by periods of heavy, intense rains which can produce considerable nitrogen losses through leaching. Thomas (1980) concluded that these losses could be minimized by delaying the nitrogen application to 4 to 6 weeks after planting. A study comparing five nitrogen rates at two times of application (at planting versus 4 to 6 weeks after planting) for conventional and no-tillage corn production has been in progress at Ames Plantation since 1979. Yield trends averaged across tillage systems are shown in Figure 3. A yield response to delayed application was observed in the wet years of 1979 and 1981. However, in the comparatively dry years of 1980 and 1982 yields were low and differences re+ sulting from when nitrogen was applied were usually small and not significant (Figure 3). Advantages for delayed nitrogen applications will vary across different seasons, soil conditions, and climates. Research should continue since nitrogen is one of the most costly fertilizer inputs in crop production in the Upper South.

As nitrogen costs have risen, interest in using nitrogen-fixing legumes as cover crops has increased. Research is being conducted in the Southeast to evaluate the potential of many species of legume cover crops prior to planting cotton, corn, and grain sorghum. A comparison of no-tillage corn yields in wheat stubble with and without vetch are shown in Figure 4. Note that the yield with vetch at the 0 N rate was not significantly different from the yield at 50 lbs N with wheat as the winter cover. This same trend for equal yields with vetch with 50 lbs less nitrogen was present at the 50 and 100 lb N/acre rates. Yields at 150 lbs N/acre rate were not significantly different with or without vetch. These data from 1982 indicate a N contribution from vetch of about 50 lbs/acre to the following corn crop. Other research is in progress comparing other vetches and clovers for adaptability, nitrogen contribution, and reseeding ability.

Many fertility problems have been solved but research on avoiding nitrogen losses and effectively using nitrogen fixing legumes in cropping systems is still needed.

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Figure 1.

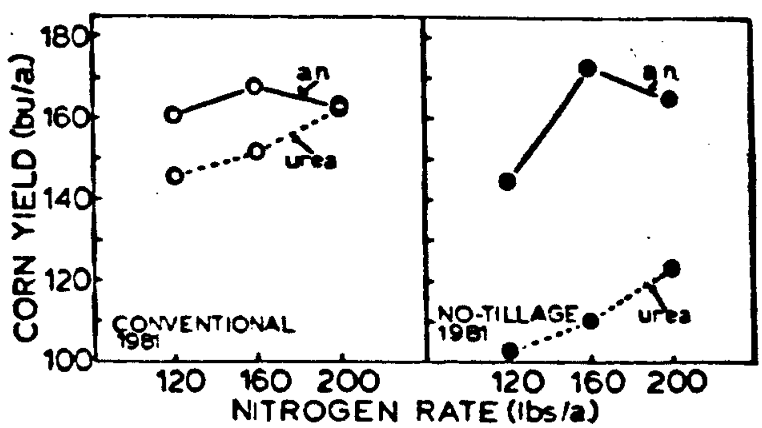

Figure 2.

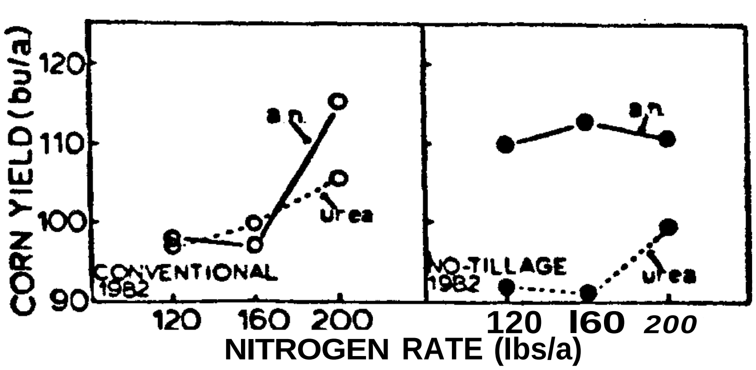

Figure 3.

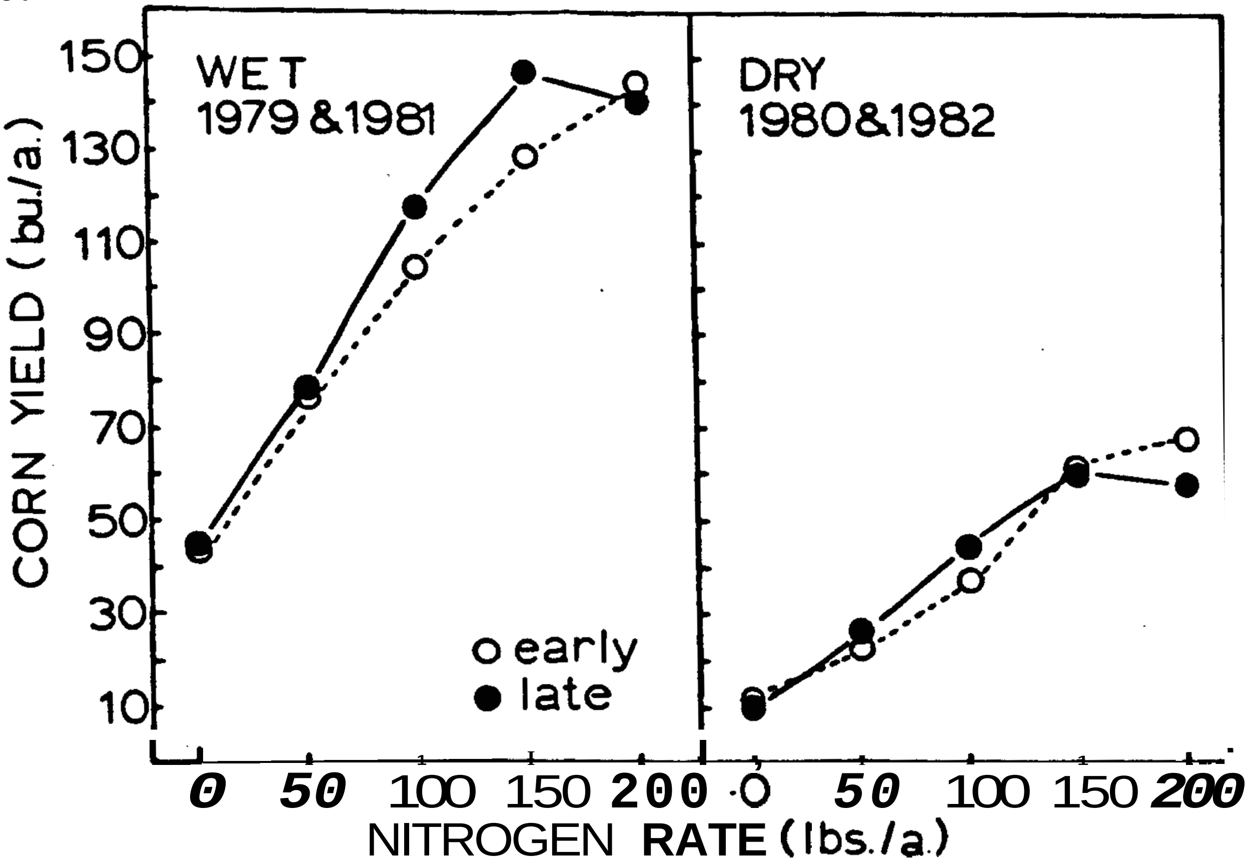

Figure 4.