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Atrazine and simazine are used for selective control of a broad spectrum of weeds in corn. Over 80% of the U.S. corn production is treated with one or the other of these two s-triazine herbicides. In Kentucky they are used annually on over 800,000 acres of corn, including over 200,000 acres of no-tillage corn. When added to the soil these compounds are ultimately degraded to non-phytotoxic compounds. The rate of degradation is dependent upon the physical, chemical, and biological properties of the soil. Although atrazine and simazine are chemically similar, simazine is considered to degrade slightly slower than atrazine after application to the soil and as a result will remain in the soil for a longer period of time.

Soil pH has long been recognized as a significant factor affecting activity of herbicides such as atrazine and simazine. Previous work by Slack in Kentucky showed more effective weed control from the triazines on soils with surface pH higher than 5.5.

Numerous mechanisms have been proposed for the degradation of triazines, such as atrazine and simazine. These include biological breakdown by dealkylation and hydroxylation to non-toxic compounds. However, chemical hydrolysis appears to be a more likely mechanism where atrazine, for example, is hydrolyzed to hydroxy-atrazine (non-toxic). This hydrolysis takes place at faster rates in low pH soils because the triazines are less stable at the low pH becoming positively charged (by protonation). Increased surface acidity also favors inactivation of atrazine by adsorption (binding) to negatively charged soil clay and organic matter.

Measurements and observations were made on a long-term (nine years of continuous corn) no-tillage study at Lexington, Kentucky to evaluate the effect of surface broadcast applications of lime on the effectiveness of triazine herbicides. The Maury silt loam soil at this site is a red, deep, well-drained soil developed from phosphatic limestone. Nitrogen treatments included rates of 0, 75, 150, and 300 lbs N/ac/yr as ammonium nitrate at planting time. All plots were visually evaluated for percent weed control and sampled for soil pH during 1977 and 1978.

The increase in corn grain yield with increasing soil pH (Figure 1) of the surface illustrates the direct relationship between pH and yield. These data were taken from treatments receiving the same level of nitrogen, 150 lb. N/ac/yr.
FIG. 1

NO TILLAGE

SOIL pH

CORN YIELD bu/ac

1977

1978
Weed control also influences the relationship of yield to soil pH. As seen in Figure 2, a good correlation exists between soil pH and percent weed control for no-tillage corn treated with 3 lb/ac (actual) of simazine. As the soil pH drops below about 5.5 for no-tillage, the percent weed control decreases at a very rapid rate. The decrease in weed control is related to an increased rate of degradation and adsorption of simazine at the lower soil pH levels.

Correlation analysis indicated that the percent active triazine remaining in the soil after 45 days gave the best correlation with percent weed control. Data for both 1977 and 1978 showed that higher soil surface pH resulted in better weed control. The additions of lime increased the soil surface pH resulting in higher concentrations of active atrazine remaining in the soil during the growing season.

Although soil pH affects weed control and is related to yields it is by no means the only parameter influencing corn grain yields. Data in Figure 3 show correlation lines for the effect of N rates on yield at various levels of weed control. The rate of nitrogen applied as ammonium nitrate at planting time had a significant influence on yields. Higher yields were obtained for the high rates (150 and 300 lb/ac) of nitrogen even with poor weed control as compared to the lower 75 lb/ac N-rate with good weed control. But, as shown, weed control is an important production management factor at all levels of nitrogen fertilization.

Use of lime on no-tillage corn with herbicides such as atrazine and simazine indicate that higher soil surface pH results in better weed control. Increased weed control can be correlated to higher yields. The application of lime as needed may prove to be a very profitable management input into no-tillage corn production systems because it slows the rate of herbicide degradation, results in greater weed control, and produces higher corn yields. Farmers using no-tillage should give particular attention to soil pH levels. High rates of nitrogen applied at the surface for no-tillage corn produces rapid acidification of the soil surface. This may require more frequent soil testing than used under conventional systems. Under no-tillage management soil test samples should be taken from surface four inches as compared to sampling the plow layer for conventional tillage systems.

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