Letters to the Editor

RE: Nitrogen Mineralization Potentials, $N_0$, and Correlations with Maize Response

Several assumptions made by Griffin and Laine (1983) are not satisfied. Among these are: 1) the nitrogen mineralization potential, $N_0$, declines weekly by the amount of nitrogen mineralized, $N_b$, 2) an implicit assumption that maize (Zea mays L.) accumulates $N$, in particular, and nutrients in general from germination until harvest, 3) a linear relationship exists between the exponential time coefficient, $k$, and a fraction of available soil water, and 4) optimum soil water content for mineralization is unaffected by amendment treatments.

The soil $N_0$ might reasonably be expected to decline if net N removal occurs through: 1) leaching, 2) gaseous loss (as NH$_3$ or N$_2$, etc.), or 3) plant uptake. Still, data from Stanford and Smith (1972) show that, even without fertilizer or a rotation sequence, the $N_0$ for a Cecil silt loam exceeded 50 mg N/kg soil after 12 years of continuous maize (Talpaz et al., 1981; Smith et al., 1980); this equals 30 to 70% of the $N_0$ for this soil under a crop rotation or receiving 180 kg N/ha/year. So, some fraction of $N_0$ is maintained and/or restored.

Jordan et al. (1950) observed near linear accumulation of N in maize from 60 days after emergence to harvest. Of their six data sets, the one reproduced in Fig. 1 most closely represents current N fertilizer application rates and plant densities (about 130 kg N/ha and 30,000 plants/ha). Even in this data set, some change in rate of N accumulation must occur within 60 days after emergence. Later work by Hanway (1962) and Mengel and Barber (1974a, b) shows two important features of N accumulation by maize: 1) N accumulation during the first 30 days after emergence is extremely small compared with that at harvest, and 2) little N accumulation occurs beyond 90 days after emergence. Thus $N_0$ may not change much until early June and during that time changes in $N_0$ reflect changes in the environment other than plant N uptake.

In attempting to correlate $N_0$, April to harvest, with plant response, an added assumption(s) is needed regarding relative plant N accumulation rates: that the rate of plant N accumulation is constant or proportional to $N_0$ + fertilizer N (residual, mineral). Work by Mengel and Barber (1974a, b) shows that plant N accumulation rates vary considerably and can reach values of $\geq 100$ mg/plant/day. Results show two distinct periods of N accumulation by a brief period (2 weeks?) with small accumulation rate (Fig. 2). When the area under the accumulation rate curve is integrated, their data pairs results so closely that they may not be significantly different (Fig. 1). Both data sets show smaller N accumulation between 70 and 85 days after emergence.

Differences between Jordan et al., and Hanway and Barber's work may be attributed to plant density, temperature, nutrient, etc., genetic or combination of these effects. The fourth data set obtained at Morris, Minn. (one of 32 such sets) had no or only a slight inflection in the N accumulation curve. Fitting this data set to a tanh(time) function (Richards, 1969) and plotting the derivative, we find maximum rates occurring about 60 days after emergence; importantly, however, total N accumulation eligible for $\geq 20$ days after emergence and decreasing at the end of the "growing season" or harvest.

In view of the nature of maize N accumulation, a correlation between a calculated $N_0$, and the April to harvest period is expected. A relation between $N_0 = f(N_0$, soil moisture and soil temperature) with yield, etc., would be interesting and expected to give a significant $r^2$. In the correlation between $N_0$ and Plant N uptake through use of multiple substrate models proposed by Molina et al. (1980).

Interestingly, Stark and Clapp (1980) observed a relation between $N_0$ and maize N accumulation in amended soils and noticed improvement in yield when $N_0$ was multiplied by $k$, the rate coefficient. Ford and Smith (1972) pointed out, $k$ equals...