This Week's Citation Classic®

Stanford G & Smith S J. Nitrogen mineralization potentials of soils.
Soil Sci. Soc. Amer. Proc. 36:465-72, 1972.
[US Soils Laboratory, Soil & Water Conservation Research Division, ARS, USDA, Beltsville, MD]

A procedure for estimating potentially mineralizable nitrogen (N_0) in soils is described, based on the assumption that nitrogen mineralization follows first-order kinetics. For 39 widely differing soils, values of N_0 ranged from about 20 to over 300 mg kg^{-1} air-dry soil. [The *SCI*® indicates that this paper has been cited in over 175 publications.]

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In the summer of 1969 I completed a postdoctorate in soil chemistry at Iowa State University and reported for duty as a new Agricultural Research Service scientist at the US Soils Laboratory, Beltsville, Maryland. Thereupon, I was assigned to the soil nitrogen research unit headed by George Stanford. Stanford was a dedicated bench scientist of exceptional experience and congeniality, and we quickly developed a close working relationship. At the time we became acquainted, the importance of keeping nitrogen fertilizer applications within reasonable bounds was becoming increasingly evident. Besides being uneconomical, excessive use of nitrogen fertilizer may contribute unwanted nitrate to ground and surface waters. Moreover, nitrogen fertilizer can be a factor in eutrophication of waters.

Our general goal was to develop satisfactory measures of soil nitrogen availability to serve as bases for calculating the amount of nitrogen fertilizer needed. This paper was specifically aimed at developing a quantitative and more generally applicable approach for estimating soil organic nitrogen made available to plants through microbial mineralization. Furthermore, we wanted an approach that could be geared to changing soil moisture and temperature conditions. Actually, our original idea was quite simple. We wished to determine a soil's nitrogen mineralization potential (N_0) and then to adjust N_0 with appropriate climatic factors. In this way, we hoped to estimate how much soil organic nitrogen would be available to a crop during a prescribed growing season.

For our study, we had available 39 agriculturally important soils representing a wide range of properties and management histories. To determine N_0, we utilized an incubation procedure conducted at optimum temperature (35° C) and moisture conditions (approximate field capacity). Moreover, because the reliability of measurements of nitrogen mineralization from extended incubation is questionable, we periodically removed mineralized nitrogen by leaching with 0.01 M $CaCl_2$. We continued the incubation for 30 weeks using leaching intervals first of two and two weeks, then four, four, and four weeks, then six weeks, and finally eight weeks to obtain sufficient time and data points to adequately describe the relation between cumulative nitrogen mineralized (N_t) and incubation period. The N_0 value was then estimated from the cumulative amounts of nitrogen mineralized under our optimal conditions. The estimate was based on the assumption that nitrogen mineralization obeyed simple first-order kinetics and our accepted value of N_0 was that which resulted in the best fit for the linear relationship between log (N_0-N_t) vs. t.

Subsequently, considerable attention was devoted to developing short-term means for estimating N_0, utilizing the concept in modeling nitrogen cycling in soils, and testing its application. Overall, applicability tests have been mixed, but with some success *in situ*,[1] the greenhouse,[2] and the field.[3] At present, field testing of the concept is under way in Kansas using undisturbed soil samples in the incubation.[4]

Interest in the N_0 concept stems from its attractive features. It is a definable soil characteristic that may be of value in predicting the nitrogen behavior of soils under changing environmental conditions. Also, N_0 provides a common basis for evaluating different chemical and biological nitrogen availability indexes and for quantitatively estimating soil organic nitrogen mineralization in the field. Whether interest in N_0 persists will most likely hinge on how practicable it proves to be for the latter.

1. **Herlihy M.** Nitrogen mineralization of varying texture, moisture and organic matter. I. Potential and experimental values in fallow soils. *Plant Soil* 53:255-67, 1979. (Cited 10 times.)
2. **Stanford G, Legg J O & Smith S J.** Soil nitrogen availability evaluations based on nitrogen mineralization potentials of soils and uptake of labeled and unlabeled nitrogen by plants. *Plant Soil* 39:113-24, 1973.
3. **Oyanedel C & Rodriguez J.** Estimación de la mineralización del n en el suelo (Estimation of nitrogen mineralization in soils). *Ciencia Investigación Agraria* 4:33-44, 1977.
4. **Cabrera M L & Kissel D E.** Potentially mineralizable N in disturbed and undisturbed soil samples. *Agronomy abstracts.* Madison, WI: American Society of Agronomy, 1986. p. 195.

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