**A simple model for predicting nitrogen fertilizer requirement of cereal crops**

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Soil testing services generally base recommendations for nitrogen (N) fertilizer requirements of crops on a soil nitrate analysis or an index of N mineralization. The soil test is related by regression analysis to observed N responses in field experiments. Three difficulties arise when this is done for dryland cropping. Firstly, season-to-season variation may result in poor correlations. Secondly, atypical seasonal conditions during calibration may invalidate the calibration. Thirdly, the relationship for one crop species may not apply to another species.

These difficulties can be overcome by using a simple model, based more on what we know about the nature of nutrient response, to predict N fertilizer requirements.

In the model, the N fertilizer required is the deficit between N demand (Ny) and soil N supply (Nsup), modified according to efficiency of soil and fertilizer use (EFF1, EFF2):

$$N_{fert} = (N_y - N_{sup} * EFF1)/EFF2$$

The N demand for a particular crop is estimated from potential yield which depends on the available water supply. Relationships between grain yield and water use are readily obtainable from the literature but are region-dependent. The relationship between grain yield and total plant N uptake is less prone to variation. The model estimates N supplied by the soil as the nitrate within the rooting depth of the crop at planting, plus that mineralized during crop growth, modified by a factor for efficiency of uptake. Nitrogen mineralization is a function of the total N in the soil, moisture (estimated from rainfall), and temperature (latitude is used as an index of temperature). While factors that influence the efficiency of utilization of soil N and of fertilizer N are not well understood, in the model they are estimated as a function of rainfall. In actual field use, rainfall cannot be predicted. In these cases, stored soil moisture plus mean growing season rainfall must be used, but this is better than taking no account of seasonal water supply.

Table 1: Test of model on some Nebraska data

| Site | N Fertilizer requirement (kg N ha$^{-1}$) | |
|---|---|---|
| | Model estimate | Observed in field |
| Boyd Co. | 106 | $\geq$100 |
| Jefferson Co. | 228 | $\geq$100 |
| Nemaha Co. | 108 | 40 |
| Dundy Co. | 0 | 0 |
| Perkins Co. | 50 | 60 |
| Deuel Co. | 30 | 40 |

The model has been programmed in Fortran and also for a hand-held programmable calculator. It has been tested on data sets for grain sorghum from Nebraska (Table 1) and Kansas, U.S.A., and for wheat from South Australia. Using actual rainfall figures it has been able to predict quite accurately whether no fertilizer was required, or whether large amounts were required. Correspondence between predicted and observed requirement for fertilizer was only fair, but in many cases confidence in the accuracy of the fertilizer requirement derived from field data was not high. These preliminary results suggest that the model has application but further testing and tuning for Australian cereal growing area is necessary.