A fertiliser model for predicting potato yields based on soil tests

J.R. Thorp and S.P. Wallace

Department of Agriculture, Tasmania Mt Pleasant Laboratories P.O. Box 46, South Launceston, Tasmania 7249

High rates of mixed NPK fertilisers, (in the order of 2 500 kg/ha of 5:6:9 fertiliser mixture) are applied at planting of potato crops in Tasmania. These rates are based on past research (1) and blanket recommendations made by the Department of Agriculture and commercial companies.

Routine soil test results point to increasing P and K levels in soils used for potato production. A model which describes the relationship of potato yield to soil fertility and applied NPK fertiliser would form the basis of rational and cost effective fertiliser recommendations and practices.

Method

For the potato cultivar Kennebec grown on Krasnozems, total tuber yields and number were collected from twenty seven, 3³ and 4³ factorial NPK fertiliser trials conducted in commercial crops by the Department of Agriculture between 1966 and 1986. The data available for each site comprised, paddock history, pH, Bicarbonate P and K (2) and factorial fertiliser levels.

A Mitscherlich based model was selected and fitted because of its common use, approximation to crop fertiliser responses and minimised the number of parameters to be estimated. The model was not required to predict yield depressions because it was only to be used for predicting economic fertiliser rates.

The Mitscherlich based model combined the variables in the form of:

 $Y = A(1-EXP^{-(aN + N rating)})(1-EXP^{-(bP + cP test)})(1-EXP^{-(dK + eK test)})$

where Y = predicted yield t/ha, A = maximum yield, NPK = applied fertiliser kg/ha, N rating = three classes of paddock fertility based on cropping history. P test and K test are the site mean Bicarbonate soil tests in ppm, a to e are fitted parameters.

The model was fitted using GLIM in an iterative procedure.

Results and discussion

The model was fitted using individual site asymptotes to allow for a variety of growing conditions.

Tuber yield was fitted with twenty seven individual site asymptotes having a mean of 81.98 t/ha and standard deviation of 21.56 t/ha. The model parameters are: a = 0.001057, N rating for heavily cropped soils = 0.8183, N rating for lightly cropped soils = 0.8631, N rating for soils having been under long term pasture = 1.186, b = 0.0137, c = 0.02481, d = 0.00534, e = 0.009986.

The model has an adjusted R^2 value of 0.84, and standard deviation of 6.15 t/ha. Predicted yields ranged from 12.1 to 90.4 t/ha. The t statistic was highly significant (P < .001) for all parameters.

Soil test and nitrogen rating parameters can be interpreted as units of equivalent fertiliser NPK. For instance N ratings 1 to 3 are equivalent to 774, 817 and 1122 kg/ha of nitrogen added as base fertiliser at planting.

The model has produced realistic fertiliser recommendations for case studies and when combined with production economics could form the basis of commercial fertiliser recommendations.

- 1. Stackhouse, K.M., Fountain, P.J., 1972 Proc. Aust. Potato Agronomy Conference 4(a)-10.
- 2. Colwell, J.D. 1970 Aust. J. Soil Res. 20:21.