Prediction of lucerne responses to lime from soil tests

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The requirements of lucerne for lime are often not able to be satisfactorily predicted from soil pH (Jones 1975). Kamprath (1970) has suggested that benefits from lime on acid soils accrue from neutralization of toxic minerals rather than pH. Thus level of selected minerals in soil may be useful as a predictor of lucerne response to lime on such soils.

Various amounts of ground limestone were broadcast on acid granite soils at Gooram and Strathbogie at the time of establishment o.f Hunter River lucerne in 1972. The amounts were 0.6, l.3, 3.5, 5 and 10 t ha of limestone (44.8% calcium oxide). The relation between production of lucerne over 4 cuts in its second year of establishment and soil tests of exchangeable aluminium (Al), available manganese (Mn) and pH in the topsoil and subsoil was examined for each site (Table l). The stepwise model operating for retention of significant ($P < 0.05$) coefficients was of the following form :

$$Y = a + bA_1 + cA_2 + dM_1 + eM_3 + fP_l + gP_3.$$

where Y = lucerne yield t ha-1, A_l, M_l, and P_1 were the levels of exchangeable A1 (ppm), available Mn (ppm) and pH respectively for the topsoil and A_2, M_2 and P_3 were the corresponding values for the subsoil.

TABLE l: Selected analytical results

Limestone	Lucerne Yield ($t\ ha^{-1}$)	Topsoil < 15 cm A_1	M_1	P_1	Subsoil 15-30 cm A_2	M_2	P_2
Gooram							
0	7.6	67	18	5.1	91	9	4.7
2.5	10.7	22	4	5.4	93	5	5.0
10	11.9	1	3	6.0	74	4	5.3
Strathbogie							
0	1.6	169	6	4.7	206	2	4.7
2.5	5.4	93	4	5.0	207	2	4.7
10	7.5	6	1	5.7	194	2	5.2

The following prediction equations were obtained:

Gooram site $Y = 15.65 - 0.05\ (0.03)\ A_2 - 0.13\ (0.03)\ M_1$... [$100R^3 = 83\%$]
Strathbogie site $Y = 8.14 - 0.03\ (0.01)\ A_l - 0.40\ (0.17)\ M_1$...[$100R^2 = 89\%$]
Combined sites $Y = 14.0 - 0.03\ (0.01)\ A_1 - 0.03\ (0.01)\ A_2 - 0.11\ (0.03)\ M_1$
... [$100\ R^2 = 89\%$]. The standard errors of the coefficients are shown in parenthesis.

Yield responses were predicted accurately from the analysis of exchangeable aluminium in top and subsoil and available manganese in topsoil. This study extends the findings of Jones (1975) who found in glasshouse studies of several soils that the response of lucerne to lime was dependent on the aluminium status of the soil.

Kamprath (1970) Soil Sci. Soc. Amer. Proc., 34: 352.

Jones, H.R. (1975) M. Agr. Sc. Thesis, University of Melbourne.