

MODELLING FERTILISER RESPONSES BY MULTIPLE
NON-LINEAR SURFACE RESPONSE FUNCTIONS

By

SIVAMATHY SIVACHANDIRAN
~

Thesis

Submitted in partial fulfilment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in the

POSTGRADUATE INSTITUTE OF AGRICULTURE

of the

UNIVERSITY OF PERADENIYA

SRI LANKA

January 2001

C 631.81
S38



530363

AGRICULTURE LIBRARY
UNIVERSITY OF PERADENIYA

530363/

ABSTRACT

In order for the farmer to increase the profit in crop cultivation, it is necessary to add optimum levels of fertiliser. To determine the optimum levels of fertiliser, the functional relationship between fertiliser levels and yield, has to be first obtained. Studying this functional relationship which is often referred to as crop response analysis, is recognised as an important area of research for developing fertiliser recommendations. However determining this functional relationship is not easy, as the response of fertiliser to yield is non-linear and asymptotic.

Several single nutrient fertiliser response functions are available to model single nutrient yield responses. But, the optimum levels that are determined by using these single nutrient response functions will not be accurate when several nutrients are involved. In Biology, interactions between nutrients are well established. Single nutrient response functions do not account for interactions between nutrients. Therefore, it is necessary to have yield response surface of several nutrients in order to determine the optimum level of each nutrient. By considering these facts, a study was designed to formulate the best non-linear multiple fertiliser response functions of some of the upcountry vegetables.

A non-linear response surface function of three nutrients with N, P and K were derived in this study. This derivation was made with the idea suggested by Baule and modifying it to incorporate soil test values into the function. Best fitting response

surface was obtained by studying several transformations to yield as well as nutrient levels. In addition, the uses of the transformation of variables of exponential forms are also discussed in this study. These exponential forms gave good fits and the Box – Cox transformation was found to be the best, due to the flexibility of the λ parameter in the Box –Cox transformation, which can accommodate different curves (shapes) of the response surface.

The optimum nutrient levels were determined by solving simultaneous non-linear equations of the first derivatives of the response surface function with respect to each nutrient. Using the methods suggested in this study, the optimal rates of six cropping situations; three (Potato, Bean and cabbage) from Badulla district and three (Potato, Cabbage and Leeks) from Nuwara Eliya district, were determined.