C-24

1992 AGRIVITA, VOL. 15. NO. 1

SPATIAL VARIABILITY OF CASSAVA TUBER YIELD ON NEWLY CLEARED FOREST LAND IN LAMPUNG AND CONSEQUENCES FOR EXPERIMENTAL DESIGN

W.H.Nugroho[1], Widianto[1] and M. van Noordwijk[2]

[1] *Department of Soil Science, Brawijaya University, Malang, Indonesia*
[2] *DLO-Institute for Soil Fertility Research (IB-DLO), POBox 30003, 9750 RA Haren, The Netherlands*

ABSTRACT

Spatial variability of tuber yields on newly cleared forest land was studied by recording yield per individual plant in the first cassava crop. The standard deviation of yield per plant was 2.18 kg or 59% of the average yield and was not significantly influenced by nitrogen rate or cropping system. Yields of individual plants were largely independent of that of neighbouring plants. Low values for a serial correlation coefficient and a high value for Smith's index of heterogeneity confirmed this conclusion. No trends across plots were identified. Variability of yields per plot can be reduced by excluding a double border row from the sampling. A cropping system without intercrop resulted in a significant increase in the minimum weight per plant in a plot, but had no effect on the maximum and had a slight effect on the mean. Nitrogen application similarly increased the minimum and had no effect on the maximum.

If differences of 20% in average yield due to an experimental factor are to be detected (p 0.05), a net plot size of 100 - 200 m^2 will be needed when 4 replicates are used.

INTRODUCTION

No field is uniform. Adjacent square meters of soil, planted simultaneously to the same variety and treated as alike as possible, will differ in as many characters as one would care to measure quantitatively. The causes for these differences are numerous, but the most obvious and probably the most important, is soil heterogeneity. Spatial variability of crop yields has consequences for the design of experiments, aimed at testing hypotheses or at estimating treatment means. As the discriminating power of an experiment increases when the error variance is reduced, efforts to control variability are essential for successful experiments (Gomez and Gomez, 1984; Pearce, 1985).

The traditional concern for selecting homogeneous plots to perform experiments may lead to biased results, however. Variability in the conditions in which individual plants which make up the population in a field, are growing, not only affects the reliability of conclusions, it may also affect the response surface itself. Van Noordwijk and Wadman (1992) showed that the yield response curve to nitrogen application changes in shape with increasing spatial variability of nitrogen supply. Results of relatively homogeneous field trials may thus be 'precise', but will not reflect the situation which farmers encounter in the real world. In stead of selecting homogeneous plots for doing experiments, we have to quantify field variability in truely representative situations and adapt our field plot technique to this variability.

Spatial variability may even have a positive effect on yield stability (risk reduction) if different parts of the field give good yields in different years, e.g. due to different rainfall patterns. Van Noordwijk and Van Andel (1988, 1989) gave a quantitative criterion for the degree of risk reduction on the basis of the within-year correlation of various components of a farm or parts of a field.

Newly cleared land may show more spatial variability than soil which has been cultivated for a long time, but little quantitative data exist. Therefore, we measured yields of individual cassava plants in relatively large plots on newly cleared forest land and treated the data as a 'uniformity trial'.

MATERIAL AND METHODS

The experiment was part of a project on nitrogen utilization by food crop production systems on acid, upland soils in Lampung, Sumatera (Van der Heide *et al.*, 1992). Plot size was 12 x 12 m, plant spacing for cassava was 0.5 x 2 m and 115 cassava plants were used per plot. Details of the experiment and yield data were given by Sitompul *et al.* (1992). At the first years harvest fresh tuber yields were recorded per individual plant.

For each plot the following basic parameters were derived: minimum, maximum, average and standard deviation of weight per plant. A serial correlation coefficient r_s was derived for rows and columns from the yield per plant, Y_{ij} (row i, column j):

$$r_s = \frac{n\sum_{i=1}^{n} Y_i Y_{i+1} - [\sum_{i=1}^{n} Y_i]^2}{n\sum_{i=1}^{n} Y_i^2 - [\sum_{i=1}^{n} Y_i]^2}$$

where $Y_{n+1} = Y_1$.

Negative values of this correlation coefficient indicate that high and low yielding plants tend to alternate,