TRANSFORMATION OF OPTIMUM PLOT SIZE USING
SMITH'S PROCEDURE

Smith found the empirical law that \( V_x = V_1/X^b \), where \( V_x \) is the variance among plots that are of \( X \) basic units in size, on a per basic unit basis, \( V_1 \) is the variance among plots of one basic unit, and \( b \) is the index of soil heterogeneity. He also showed that if the cost per plot without guard rows is \( K = K_1 + K_2 X \), then the cost per unit of information would be minimum if

\[
X = \frac{bK_2}{(1 - b)K_1}
\]

where \( X \) is the size of the plot, \( K_1 \) is the part of the cost that is associated with the number of plots only, and \( K_2 \) is the cost per unit area. Smith, in his numerical example, defined \( K_1 \) in man-hours per plot and \( K_2 \) in man-hours per square foot.

This method was used by many authors to estimate the optimum plot size for different crops. In some of these papers, apparently, Smith’s formulae were not used correctly. The same error was repeated in several papers and might possibly be made again. It therefore seems appropriate to point it out. Some examples of possible misinterpretation follow.

Robinson et al. assumed that 30% of the total cost was proportional to the total area used. They inserted 70/30 for the ratio \( K_1/K_2 \) in equation [1] and calculated the optimum plot size, \( X \), from this equation in terms of the basic units used in the uniformity trial. Similar procedures were used by Elliott et al. and Pointer and Koch.

According to the original definition, both \( K_1 \) and \( K_2 \) are constant for different plot sizes, but \( K_1 \) is given on a per-plot basis and \( K_2 \) on a per-unit-area basis. The percentages of the two types of costs from the total cost, however, are proportional to \( K_1 \) and \( K_2 X \), respectively. Thus, the ratio calculated by the above-mentioned authors and used in equation [1] was actually \( K_1/K_2 X \) and not \( K_1/K_2 \). This ratio is dependent on the size of the plot \( (X) \) from which it was estimated, and it would not be correct to use it in the equation.

Smith’s coefficient \( b \) is the linear regression coefficient of the logarithms of \( V_x \) and of \( X \). It is not dependent on the size of the basic units used for its estimation. It would therefore be incorrect to calculate \( X \) from equation [1] in terms of the basic units used to estimate \( b \). The only term in the equation that is expressed on a per unit of area basis is \( K_2 \).

Notes

The correct procedure would therefore be to estimate \( K_2 \) on a per unit of area basis and calculate \( X \) in terms of the same unit of area.—A. Marani, Instructor, Faculty of Agriculture, Hebrew University of Jerusalem, Israel.