# THE BIOMETRICAL ANALYSES OF INTERCROPPING EXPERIMENTS : SOME PRACTICAL ASPECTS WITH THE REFERENCE TO INDONESIAN INTERCROPPING EXPERIMENTS

A thesis submitted by

WAEGO HADI NUGROHO
Ir. (Agricultural Engineer)
Brawijaya University (Indonesia)

to

The University of Adelaide
for the degree of
Doctor of Philosophy

Biometry Section,
Waite Agricultural Research Institute,
The University of Adelaide.

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# SUMMARY

Most statistical analyses and designs developed for agricultural research are primarily meant for sole crop experiments. In intercropping experiments, however, the development of both designs and analyses is relatively primitive. In this thesis several biometrical techniques for intercropping are investigated. The suitability of these techniques is illustrated by analysing data from 51 Indonesian intercropping experiments.

The biometrical techniques used here have been applied to investigate three important aspects of intercropping experiments. The first aim is to assess the validity of the assumptions underlying the models and also to develop the previous models in order to assess yield advantages in intercropping. The second is evaluation of the cropping systems × environmental interactions and yield stability for intercropping. The third is a discussion of the role of competition analysis in intercropping experiments. The thesis also provides guidance on experimental designs for Indonesian intercropping experiments.

The assumption underlying two popular models in intercropping the Land Equivalent Ratio (LER) (Mead and Willey, 1980) and bivariate analyses (Pearce and Gilliver, 1978, 1979) are examined in Section IV.1. The LER is quite satisfactory as regards distribution and homoscedasticity as long as there are no outliers in the data. It is shown that for many data sets and analyses, the hypothesis of equality of correlation needs to be tested as well as that of equality of treatment means in the bivariate analysis of variance. Since there are two characteristics of interest (the two separate crop yields), then without knowing the criterion of "the best", the problems of choosing the best treatment will not be solved. Univariate and multivariate analyses are investigated in order to determine how best to assess the degree of yield advantage for intercropping systems (Section IV.2). The study emphasizes that more than one

analysis should be done in order to get a better understanding of the nature of any yield advantages. The joint use of LERs and bivariate analysis is suggested as the two methods complement each other. In order to have a comprehensive result, the study offers an alternative criterion of the best treatment, a new effective LER (LER'). The best treatment is defined as that which has the yield of the main crop meeting the farmer's requirements and which also has the highest biological efficiency in terms of LER'.

In view of the problems encountered in assessing both the interaction of cropping systems and environments and also yield stability in intercropping systems, the study treats these aspects extensively (Chapter V). On analysing the Indonesian intercropping data, one concludes that the experimenters seem not to realize the importance of these factors for intercropping systems, as few relevant experiments have been conducted. Accordingly, any conclusions must be tentative in the extreme, but the results have the merit of merging the study of cropping systems or cropping combination × environmental interaction for Indonesian intercropping experiments.

The usefulness of the bivariate graphical method (Pearce and Gilliver, 1978, 1979) is highlighted in Chapter VI in examining the nature of competition analysis for intercropping experiments. The study develops this technique and emphasizes that without distinguishing the degree of yield advantage, most published competition functions are largely uninformative. It is proposed that in order to have a better understanding of the final yields, one must consider growth and other characters of crops under intercropping.

Experimental design considerations and guidelines in designing Indonesian intercropping experiments are discussed in Chapter VII. The study shows that the experimenters in some cases have been confused about the objectives of experiments and consequently about relevant experimental

designs. Much closer collaboration is needed between experimenters and statisticians; the lack of statisticians or biometricians in Indonesia may cause major problems in applying even the existing statistical methods for intercropping experiments. This has important implications for agricultural practice in developing countries.