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1. The use of linear regression graphs in the determination and prediction of yield behavior in maize.

Since the development of this method by Robbertse (unpublished D.Sc. (Agric.) thesis, University of Pretoria, 1969 and MNL 44:180), it has been extensively studied and used in practice. The results to date show it to be appreciably more useful in breeding and cultivar choice than any other known statistical determination.

Due to the very high genotype-environment interaction in maize in Southern Africa, single trial averages are extremely unstable and relatively useless. Global averages over a large number of trials, although more stable, have little predictive value for the varying conditions under which any maize cultivar will be grown. As Robbertse showed, grouping of trials in order to reduce genotype-environment interaction is so unstable over years, that its value is highly suspect.

These conclusions were strongly supported by the work of Wickens (unpublished D.Sc. (Agric.) thesis, University of Pretoria, 1971) on double hybrid predictions, using the above statistics as well as regression graphs.

The results of Robbertse and of later workers have shown that the regression of specific cultivar yields on average trial yields is highly linear with R^2 values in the region of 90%. Only with very large numbers of trials ($\pm$100) do some cultivars give a significant although very slight curvature. Furthermore, when using the average of

the same entries as the independent variable, the linear regression graphs are amazingly stable over years so long as the variance of the independent variable is sufficiently large.

The indications are that mean yield (the independent variable) is a sufficiently complete measure of the factors that influence specific cultivar yield. As a result, the regression lines are highly linear and stable. Furthermore, they give an extensive and easily seen indication of the adaptability of the cultivars over the range of conditions that have been sampled in the trials.

It has been found by Nelson (personal communication) that in Rhodesia under the pertaining high yield potential, the graphs are sensitive to population density. This aspect is being studied and may have to be taken into consideration in the practical application. It would also affect other existing methods. Nevertheless, the method allows a uniquely high and acceptable degree of predictive accuracy in regard to yield. In extensive practical use in Southern Africa it would seem to be a very important breakthrough in maize breeding. Further research into the application of the method is under way.

It is interesting to note that all the arguments in favor of the use of regression coefficients as stability selection criteria, as suggested by Finlay and Wilkinson (Austr. J. Agric. Res. 14:742-754) and Eberhart and Russell (Crop Sci. 6:36-40), also apply to this use of regression, with the important expansion that this method not only allows the use of nearly all the definitions of stability, but also gives an extensive indication of the yield performance characteristics of the cultivars in the case of maize. Its use for other characteristics and other crops has not as yet been tested.

The one known disadvantage is that this method contains all the problems of common linear regression analyses.

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