Relative Efficiency of Rectangular and Triple Rectangular Lattice Designs Using Hop Uniformity Trial Data

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Numerous investigations have been reported concerning the efficiency of incomplete block designs relative to randomized complete blocks. These investigations have been limited, in general, to cereal crops involving a large number of entries where the use of incomplete block designs has usually resulted in a gain in efficiency. Greater gains in efficiency have been reported on heterogeneous soils. These studies, in addition, have been confined to experimental designs in which the total number of entries in an experimental trial is equal to the square of a number.

Incomplete block designs which are limited to $k^2$ entries, where $k$ equals the number of plots in an incomplete block, are widely used by investigators working with annual crops. An objection to the restriction of $k^2$ entries is that it often necessitates including in the experiment a number of “filler” varieties to complete the square. This difficulty is of more importance where perennial plants are involved, since these experimental trials are usually conducted for several years on the same site. The solution for the analysis of the rectangular lattice (3) and the triple rectangular lattice designs (4) presents an extension of the incomplete block design to the case when the number of entries is expressible as the product of two consecutive integers. The introduction of the rectangular and triple rectangular lattice designs provides the investigator with additional incomplete block designs which may reduce the number of “filler” entries to complete the experiment.

The objective of this investigation was to examine the efficiency of rectangular and triple rectangular lattice designs relative to randomized complete blocks using hop uniformity trial data.

Review of Literature

Studies on the efficiency of experimental designs have been reported for a variety of crops by a number of investigators. General findings will be noted, without any particular reference to a particular investigator.

The efficiency of incomplete block designs relative to randomized complete blocks has been investigated on sets of uniformity trials. These investigations have been limited to $k^2$ entries involved. In general, these studies have indicated the desirability of using incomplete block designs in increasing the precision of field experiments involving a large number of entries. Bancroft and Smith (1) presented varietal tests that suggested the use of incomplete block designs for a relatively small number of entries.

Materials and Methods

The experimental procedure used in collecting this investigation was reported in a previous study. Incomplete block designs (lattice, lattice square, and triple lattice) were superimposed on the experimental area. The efficiency of the design based on the average per plot was compared with that relative to randomized complete blocks.

Rectangular and triple rectangular lattice designs 5-hill plots and 5-by-1 hill plots were superimposed on the experimental area. This permitted a method of measuring the efficiency with that relative to a randomized complete block design. The efficiency was computed as a ratio of the variance between two varieties as suggested by Harshbarger (3). A discussion of the mathematical analyses of variance and the triple rectangular lattice designs has been presented in detail by Harshbarger (3, 4). In addition, Harshbarger presented a section of each paper to the numerical analysis of the field, the numerical computations for the analysis of variance between two varieties as suggested by Cox (2).

Experimental Results

This investigation was restricted to a comparison of the efficiency of the rectangular and triple rectangular lattice designs relative to randomized complete blocks using hop uniformity trial data.