used with six replications. Thus, it would be possible to gain a broader view of the material in the preliminary phases of the breeding work.

The use of the three dimensional plan may be adapted to the degree of accuracy desired and apparently can be used with confidence.

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COMPARISON OF QUASI-FACTORIAL AND RANDOMIZED BLOCK DESIGNS FOR TESTING SUGAR BEET VARIETIES

A. W. Skuderna and C. W. Doxtator 1/

In order to obtain statistically significant differences between varieties or treatments, it is imperative that factors which influence error variance are adequately controlled. This can be accomplished in part through more critical selection of experimental fields, and in part through more efficient plot arrangement. However, experiments involving a large number of varieties or treatments, the size of the replications may become so large that plot variability of the test cannot be efficiently controlled.

In recent years there has been a growing tendency on the part of experimentalists to group classes of data into smaller and more homogeneous subclasses rather than using randomized blocks of larger size and possibly greater

plot variability. As a result, quasi-factorial arrangements have been described by Yates 2/ and Goulden 3/ who reported gains in efficiency ranging from 26 to 57 per cent and 20 to 50 per cent respectively. Le Clerg 4/, employing the two dimensional quasi-factorial design and randomized block design, reported results of tests conducted in 1937 and 1938. In these tests, the relative efficiencies of both types of plot arrangements were compared. Using 36 treatments in the test for control of damping off organisms, the conclusion reached was that the quasi-factorial plot design was more efficient than the randomized block design in some seasons.

The purpose of this paper is to report the results obtained from 11 variety tests with sugar beets, each of which was analyzed as a symmetrical incomplete block experiment, and as randomized block experiment.

Materials and Methods

The eleven variety tests of sugar beets were conducted in the following areas: seven near Rocky Ford, Colorado; two near Alamosa, Colorado and two near East Grand Forks, Minnesota. Four of the tests contained 9 varieties each, four contained 16 varieties each, two contained 25 varieties each and one contained 49 varieties. All tests were conducted during 1939, with the exception of the 49 variety test, which was planted in 1938. Each of the eleven tests were designed as a symmetrical incomplete block experiment. Randomization was practiced on the varieties which were allocated in each set (or block) and blocks were randomized within the replicates.

The percent of efficiency of the symmetrical incomplete block analysis in relation to the randomized block analysis was determined from the mean square for error obtained from each analysis. In Table I is given these percent efficiency figures.

Table I.—Increase or Decrease in Percent Efficiency of the
Symmetrical Incomplete Block Design as Compared
With a Randomized Block Arrangement of Equal Size
in Variety Tests with Sugar Beets

No. Varieties in Test	No. of Tests in average	Average Percent Increase or Decrease		
		Tons Beets	Percent Sucrose	Lbs. Sugar Per Acre
		Rocky Ford, Colorado, 1938		
49	1	+ 25	+ 43	+ 48
		Rocky Ford, Colorado, 1939		
25	2	+ 3	+ 80	+ 5
16	2	— 11	+ 10	+ 10
9	2	— 11	+ 37	— 16
		Alamosa, Colorado, 1939		
16	1	+187	+182	+226
9	1	— 5	+ 23	— 10
		East Grand Forks, Minnesota, 1939		
16	1	— 16	+ 14	— 3
9	1	+ 30	— 8	+ 14

Discussion

The results obtained indicate a loss of precision in the 9 variety tests at Rocky Ford and Alamosa in tons beets and pounds sugar per acre, and a loss in precision in percent sucrose at East Grand Forks by the use of the incomplete block design. In the 16 variety tests a loss of precision was found in tons beets per acre at Rocky Ford and in tons beets and pounds sugar per acre at East Grand Forks. A great increase in precision was observed in the 16 variety test at Alamosa, Colorado. Extremely variable irrigation practice in part accounted for the greater error of the randomized block analysis in this test. In the two 25 variety tests and the 49 variety test at Rocky Ford, increase in precision in tons beets per acre, percent sucrose and pounds sugar per acre was obtained in varying degrees. 5/

Conclusion

From the comparisons of analysis methods herein reported it is indicated that the symmetrical incomplete block design is likely to be less efficient than the randomized block design in tests of 16 varieties or less; and approximately equal to or better than the randomized block design in tests of 25 varieties. In tests of 49 varieties the incomplete block design is likely to be much more efficient than the randomized block design.

1/ Manager and Plant Breeder respectively, Beet Seed Operations, American Crystal Sugar Company, Rocky Ford, Colorado.

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5/ Under the conditions of these tests, leafspot incidence was not a factor. It is therefore not known as to how much bias would be introduced under such conditions in applying the correction factor (which is fundamental to this symmetrical incomplete block method) to variety yields of varying degrees of resistance to leafspot.

THE INDUCTION OF POLYPLOIDY IN BETA VULGARIS L. BY COLCHICINE TREATMENT

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The plumule region of small sugar beet seedlings was treated, by the single drop method, with colchicine in concentrations of 0.2 and 0.4 percent. The application of colchicine was repeated either four or eight times during successive days. The following selections, designated by current number, were given such meristem treatments:

    2241 .... Munerati annual. Low self-fertility.
    6499 .... Annual "wild" type from Milpitas, California.
            Low self-fertility.
    2245 .... Plantain foliage venation type. Biennial in bolting character.
            Low self-fertility.