A CROP ROTATION FIELD LAYOUT WITH AN ILLUSTRATION OF THE STATISTICS INVOLVED IN COMBINING SEVERAL YEARS' DATA

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At a 1939 meeting of agronomists and others interested in the production of sugar beets in Michigan, attention became centered on the lack of experimental results pertaining to crop rotation and sequence. It was impossible to answer from experimental evidence such questions as, “What crop should immediately precede sugar beets in the rotation?”; “Are legumes essential in the sugar beet rotation, and if so, what legume is most desirable?”; “What proportion of the rotation time should be allotted to the production of soil building legumes?”

To obtain satisfactory answers to these and other questions, the Ferden rotation and crop sequence experiment was started in the spring of 1940. It is the object of this article to present the field plans and problems of manipulation and to show how the data from such a layout may be statistically analyzed. The results obtained from the main crop, sugar beets, during one complete rotation are presented in full. The 1940 results are not considered because it required that one year to get the rotations started; even in 1941 there were still some irregularities. Not until 1942 did sugar beets actually follow two years of alfalfa and, in the case of rotation 7, it was 1942 before the crop could have been affected by sweetclover seeded in 1940.

PLAN OF EXPERIMENT

This experiment is being conducted on the Ferden farm in Saginaw County, 4 miles south of Chesaning. The soil over the experimental area, containing 25 to 28% clay and 50 to 58% sand, is classified as sandy clay loam. It has been placed in the Brookston series. The field is tiled, but drains rather slowly.

Seven five-year rotations, shown in Table I, are being studied. The plots are arranged in a split-plot randomized block design. All crops appear each year and treatments are replicated four times. Two crops, barley and sugar beets, appear in all the rotations. Corn appears in all but one of the rotations.

The field outline for block 1 is shown in Fig. 1. Each individual crop plot is 28 x 90 feet. The rotations were randomized in each block with each rotation occupying five plots in each of the four blocks. The total number of plots in the experiment is thus 5 x 4 x 7 = 140. Each plot is further divided into two sub-plots 14 x 90 feet each. One sub-plot receives fertilizer at the rate of 400 pounds per acre in five years, while the other receives 1,000 pounds during the same period. In both cases one-half the fertilizer is applied for sugar beets and the other half for grain, all for barley in rotations 1, 2, and 3, and divided between the two grain crops in the other rotations. On all crops the fertilizer used is 2-16-8. When the experiment was laid out a coin determined which sub-plot received the high treatment.

To facilitate the tractor work on the plots, it was decided at the start of the experiment that crops would not be placed entirely at random in the five plots within a rotation, but would be grouped as much as possible so all of one series (A, B, C, D, or E) would grow a common crop. Thus it was decided, by chance, that in block 1 barley should be grown in series B in all rotations (Fig. 1) and that corn would be grown in series A and sugar beets in series C. Of course, for rotation 2 the positions of corn and sugar beets were reversed and in rotation 3 barleys replaced corn. The rotations offered no difficulty, however, as the land for each crop can be fitted at the same time. With this arrangement the plowing and fitting of three series in each block across the plots with all seven plots being worked simultaneously.

The other two crops in each rotation were placed entirely at random in the five plots. In the two series, D and E, the order of occurrence, in the other two series, D and E, is reversed.

Use of manure and disposition of crop residues will be according to the systems of farming which might be conducted with the different rotations. In rotations 1, 2, and 3, 10 tons of manure per acre are applied for corn or beans, and with a rotation like 4 or 5, with only 20% of the land producing hay, would keep fewer livestock so that the application for those two rotations is 7 tons per acre. Manure is applied in rotations 6 and 7, because on these farming systems, no livestock would be raised.

Corn stover is left on all the plots. Grain and sugar beet tops are returned to the plots in rotations 4, 5, 6, and 7.

 Alfalfa is seeded with barley in rotations 1, 2, and 3, with oats in rotation 4. A red clover and timothy is seeded with oats in rotation 5. Sweetclover is seeded with both grain crops in rotation 7 and is plowed under for beans and corn. This sweetclover seeding provides the difference between rotations 6 and 7.

All plowing has been done in the spring. Oats have been planted after barley and beans, respectively, and out plowing. All other plots have been plowed four times, according to the systems of farming which might be conducted with the different rotations.