LONG-TIME CROP AND FERTILIZER ROTATIONS

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The first paper of this symposium on the Design of Long-Time Experiments covers crop and cultural aspects; the third, experimental design; and this, the second, is limited to long-time field experiments from the standpoint of soil management research. But, first, to set the stage, I shall discuss some of the general features of soil management research which apply equally to short and to long-time experiments.

Agricultural research is intended to develop principles a farmer may use to obtain maximum returns for his efforts while he maintains his soil heritage intact. Farms vary widely as to soil, size, labor supply, and facilities; climate varies; demand and price for a given product vary from place to place and from year to year; and farmers differ as to managerial ability, likes, and dislikes. So it is almost impossible to set up a best farming system applicable beyond a single farm. Yet it is our job as agricultural scientists to develop principles the farmer can apply to work out a best system for his farm. We are obligated to provide the farmer with the best information available. This does not imply that we will conduct experiments on every farm, but it does imply that we may develop principles that will apply to every farm. As scientists we are interested in establishing far-reaching generalizations.

There are many experimental problems that are interesting, but among them are those that are not only interesting but have intrinsic value because of their implications. As agronomists we might set up equipment of many kinds at a great variety of places. We could measure rainfall intensity, air temperature, barometric pressure, relative humidity, sunshine intensity, and wind velocity; soil temperature, soil color, soil organic matter, soil moisture holding capacity, the effective size of soil pores, soil exchange capacity, soil exchangeable bases, soil shearing strength, soil capillary potential, and numerous other characteristics; and, in particular, we might measure the crop yields that result from particular treatments. All information of this kind would be interesting, of course, but we should have good reasons other than this for making the measurements. If we accumulate vast quantities of experimental data that are not well motivated, we will be wasting a lot of time. For example, suppose we brought a high school student into a laboratory and provided him with several batteries, wires of various lengths, diameters, and materials, an ammeter, and a voltmeter; then instructed him to connect the wires in various combinations to the batteries, and measure the current and voltage; and expressed in the simple statement of Ohm's law.

Some of our agricultural experimental work is of this kind. We start with soils that vary in many ways, apply various treatments, and observe crop yields. We amass all kinds of data. It would be tremendous help if there were a few general principles that could be used to organize and correlate these data. I believe it may be possible to formulate such relationships and I believe it would be interesting to look for them.

LEARNING TO APPLY RESULTS

Many of us have placed an obstacle through a firm conviction that the results from field experiments will be applicable only to the narrow range of soil and climatic conditions by the site on which the experiment was conducted. Because of this belief we set up a number of treatments for an experiment and then scatter these experiments hither and yon in an attempt to determine what will happen on any soil type. Such experiments change somewhat with use, and, more particularly, because the weather is different each year, from place to place and from year to year. It is the same things and getting results that are quite contradictory.

It is a fact that many of the results from collecting from our field experiments are applicable to the soil type and season represented by the test. And it is also a fact that as long as we set up the experiments this will be true. What is sobering is that a hundred years from now we will still have to conduct the same experiment and will still have to speculate on how to treat the soil. It should be possible to set up an experiment in Utah, for example, from which general principles may be developed that will apply in Ohio, Maine, or North Carolina. And it is also a fact that results may be obtained one year and not apply every year.

Is this all a pipe dream? To be sure, it is true that at present, for measurements will be required that we do not know how to make. But there is the slightest question that we can learn how to make these measurements. In order to build bonds, it was necessary to learn how to make sandths of an inch. In agriculture we are still measuring with yardsticks, and still trying to measure with no marks on the stick.

Consider the progress that has been made in the field of soil moisture research. When I was a child, I can remember that very little was known about sandths of an inch. It was not until very recently that accurate techniques were developed. But the problem of determining the amount of water in a soil was solved. It is a simple matter to determine the amount of water in a soil. Just as in agriculture we are still trying to measure with yardsticks, we are still trying to measure with no marks on the stick.