Agricultural Production

Hypothesis and Progress

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The agricultural scientists should feel as free to use and express hypotheses and theories as a backlog to experimentation and scientific proof as do workers in other fields of science . . . Such speculative thinking can be most stimulating to other workers

WE ARE ALWAYS IN DANGER of bogging down in our skills. When I was a soils scientist about 1922 every Ph.D. candidate stood a good chance of passing if he could set up a hydrogen electrode apparatus and explain pH authoritatively. On his first job, pH values were important and frequent. Styles changed; soon soil colloidal behavior was the significant factor, then base exchange, oxidation-reduction potentials, phosphate behavior, x-ray patterns, radioactive elements, tracers—all had their day. Yet there is more to come.

When we are young scientists, we carry great skills in technology. When we are older, we have forgotten some of this, and experiences have dragged in a lot of other limiting factors outside of our skills. Perhaps this is wisdom. Wisdom and science do not necessarily travel together. Wisdom travels more easily with the philosopher, because the philosopher can use reason and imagination where proof is lacking.

The agricultural scientist finds himself needing to be, on the one hand, a scientist and an introvert and, on the other, a teacher and an extrovert.

The old arts behind agriculture tend to hold agricultural people in the comparative calm of going Grandpa's way, whereas the unorthodox pressure of scientific facts and thought come with a relentlessness often disturbing because the new often kills the old.

This is an interesting phenomenon because life is made most fascinating by it. It makes the future promising. It is something attractive to young people because their future is part of it. To old people with their "stakes driven down hard" it is not always welcome. Here is a good way for the aging to remain plastic in thought and action so as to be more with the times.

Because of the "arts of agriculture," the agricultural scientist has been slow or hesitant to express his more advanced thoughts. He has not advanced his hypotheses freely because practical people may read his speculative thoughts, regardless of how constructively they are synthesized on experimentally proved facts, and infer that he considers them proved facts.

We tend to miss the rich margins of a scientist's mind if he publishes only his proved work. The imagination on which he draws in speculative thinking before experimenting can be most stimulating to another scientist.

The fact that the agricultural scientific field has such a vast audience of laymen (with respect to science), although well educated people, the agricultural scientist has not been as free to use and express hypotheses and theories as a backlog to experimentation and scientific proof as have the astronomer, physicist, and chemist. Handling hypotheses as if they were facts is, of course, indefensible. Unfortunately this does occur at times.

Any scientist shares with me his particular experiences with cases similar to those shown on the next page with which I am intimately acquainted.

Today a Hypothesis Tomorrow a Reality

On the basis of experience with unproved ideas, we might risk a few new or additional hypotheses. Progress today in the scientific field is so rapid that proof may be forthcoming soon. Any hypothesis ventured here is likely a reality with some.

Crop rotations are no longer necessary. This is hardly proved true as yet, but facts point to a hypothesis that says it may work. Crops are rotated in many areas to obtain extra nitrogen and organic matter from the legume crops as well as to prevent erosion, certain diseases, and pests. Adequate use of synthetic nitrogen with mineral fertilizers, mulch practices instead of clean cultivation, extra stands for higher yields, more crop residues, plus the use of sprays for pests, diseases, and weeds point to new economic opportunities for specialized crop production.

A Midwest farmer cannot afford to grow oats. He does not need them for the straw for bedding or for a legume nurse crop. Other crops can do these tasks more economically. Corn can be used as a nurse crop. A very successful Illinois farmer uses alfalfa for bedding.

Neither can a Midwest farmer afford to grow his old stand-by, red clover. He

Case No. 1

In 1928, the "black belt" heavy clay soils of Alabama were failing to respond to any normal nutrition additions. Theory associated phosphate fixation to the clay fraction of the soil. The sandy loams (10% clay content) responded well to about 50 pounds per acre of P_2O_5. This amount of P_2O_5 had given no response on the black belt soils with 50 to 80% clay content, but when the rate of P_2O_5 was applied more in proportion to the clay content— to the extent of 250 to 400 pounds P_2O_5 per acre— the response was astonishing.

Case No. 2

In 1926 the middle-west soils "needed no nitrogen or potash with lime, phosphates, and legumes." Theory said that with 30,000 to 40,000 pounds per acre present per acre foot, no applied potash was needed for the crops.

Here the theory was wrong. But a lot of experimentation was wrong too. The Hoffer corn-stalk potash test indicated that potash was needed, but the Wooster, Ohio, agronomy plots, where potash had been added showed no response. Therefore, the stalk test, which was largely theory, was believed wrong. The fact developed years later (about 1940) that not enough potash had been added in the experiments and that the crops were truly deficient in potash as the stalk-test showed.

Case No. 3

In 1939 "dry weather firing" of corn was accepted in the corn and cotton belt as lack of water. The fact that there was less firing where the soil was dark or black was acceptable "proof" that the higher organic matter content supplied more water, thus less firing. When legumes supplied some nitrogen, there was less firing. Yet, we saw firing in corn which had been preceded by clover and where the yield was 60 to 80 bushels per acre. It was risky to hypothesize that this firing could be nitrogen starvation and that more nitrogen (up to 120 or more pounds per acre) might give a response and cure the firing. But that proved true.

can get both nitrogen and organic matter cheaper from synthetic nitrogen and nonlegume higher value crops, if he likes. As a forage crop, alfalfa is better.

I have a hypothesis that in fertilizing corn in the north, the ***greater share of the applied nitrogen should be placed as an ammonia carrier deep under the row, with a starter fertilizer,*** applying 10 to 30 pounds N, 75 to 100 pounds P_2O_5, and about 10 to 20 pounds K_2O near the seed at planting and the greater bulk of the potash applied broadcast a previous year. This is a practice I am using with excellent results on my own farm. The fundamental experimental work behind this thinking has been reported in Purdue University Experiment Station Bulletin 482, reprinted in 1944, and is recorded in detail in Ph.D. theses by A. J. Ohlrogge, B. A. Krantz, H. L. Cook, and Mack Drake, also of Purdue.

We cultivate too much. Saving in expensive labor and power and gains in conservation of the soil make this attractive, but proof of adequate substitutes are needed—perhaps overdue.

Nematodes are a big limiting factor to the most effective use of fertilizers. Nematodes are responsible for much poor growth attributed to impoverished soils.

The northern farmers are losing a big natural resource of daylight by letting much of the long daylight of spring to June 21 go to waste. Early applications of nitrate nitrogen would start plant growth before the soil warms and begins the decomposition by nitrogen-producing microorganisms.

The natural forage area of our new scientific age coming will be in the South, where there are more growing winter days than in the North and where rainfall is above 40 inches per year.

There is no end to this type of guessing. As hypotheses, these statements are justified, but I can already hear someone say: "Where is your proof?"

The author demonstrates use of the Hoffer corn-stalk test for potash in an Indiana corn field

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