

## FERTILIZERS AS SUPPLEMENTS TO MANURE.

We have taken the ground that it will never be economically, even if scientifically, possible to maintain soil fertility by the exclusive use of fertilizers. Our belief is that we can use them only as supplemental to, and not as a substitute for, manure. We have obtained, if you look through our records, in many instances a very fair monetary return from the use of certain combinations. It depends partly upon the condition of the soil and crop to be grown and partly upon the combination of fertilizing material and the amounts that we use. For instance, we might find a monetary profit from using 300 pounds, per acre, of a certain fertilizer, whereas an application of 500 pounds might result in a loss. This sounds paradoxical. A farmer sometimes reasons: If a certain amount is good, more is better. Not at all. That is not the way to look at it. The point is not so much increase in the yield as increasing the profit. We have to take into consideration the cost of the fertilizer: 300 pounds of a certain fertilizer will not cost as much as 500 pounds. Now, there might be an increase if 300 pounds were used, and there might be a greater increase if 500 pounds were applied. But the difference between the increase in yield from 300 pounds and that of 500 pounds might not equal in value the difference in the price of 300 pounds and that of 500 pounds. There are many aspects to be considered. Every farmer who decides to use fertilizers should undertake some experimental work to ascertain the needs of his soil. Each experiment should have its check plot for the purpose of comparison.

We want our men to understand the requirements of their crops, to understand something in regard to the nature of their soils, and of fertilizing materials. We want them to understand first of all what rational farming means, namely, the return of a large proportion of the plant food which crops take from the soil, thus keeping up soil fertility without the direct purchase of plant food. There are only two means of doing this, one producing manure and its right use, and the other the growth of clovers. This I have already explained. Farmers should be taught that when they use fertilizers it must be as supplemental to all these rational means, rotation of crops, application of manure, proper cultivation of the soil, and so on. Then, we may hope, with a sufficiency of intelligence, to expect from the judicious use of fertilizers a profitable return.

## ESSENTIAL ELEMENTS IN FERTILIZERS.

There are three elements which may be present in compounded fertilizers: when all three elements are present, we term that material a complete fertilizer. Our experiments have included trials with various forms of nitrogen, phosphoric acid, and potash, singly and in all combinations. Looking over the whole field, we conclude that in the larger number of instances where a profit has been obtained it has resulted from the application of a complete fertilizer; that is to say, from the use of a fertilizer that contained all three elements. There seem to be good reasons for such a result. My impression is that the chief function of the fertilizer is to raise the percentage of the very small amount of plant food that is immediately available for use. There is never a very large percentage of this immediately available plant food, and I think the function of the fertilizer is to increase it rather than to add to the total store of plant food in the soil, much of which is unavailable.

## THE LAW OF MINIMUM.

We also know this fact, that the growth of crops is limited by the percentage of plant food which is present in minimum. If there is an excess of nitrogen, an excess of phosphoric acid, but only a small amount of potash, then the growth is in proportion, and is limited by that minimum percentage of potash which is present. I think that that is probably the chief reason why it is desirable and profitable in the majority