

EDUCATIONAL SERIES

Great Crops By Scientific Soil Culture

By H. W. Campbell

If you will take a peep into the annual report of the department of agriculture you will discover that in no other part of the country has the average yield of wheat been so much increased in recent years as in Nebraska. You will not find any specific explanation of the fact. But there's a reason.

Another thing that will impress the student, if he goes very deeply into the subject, is that the greatest increase in area in ordinary farm crops, is in the states which are in or border upon what is spoken of loosely as the semi-arid region of the country. That means that agriculture is crowding back the desert. It indicates that the area of soil given over to ranges or to sheer waste is being lessened all the time. It means that farms are being cultivated right now where for years it was regarded as impossible to grow anything save short grass and small brush. There's a reason for all this.

I feel sure I do not overstate the matter in asserting that no one subject is attracting greater attention through the world of agriculture than that of how to enlarge the area of tillable land and increase the productivity of the land already used. This is the field of scientific soil culture.

In a sense this is very gratifying to me. I can not but feel that the position I have maintained for a long time, most of the time almost alone, has been vindicated by the logic of events. The attitude of the public toward scientific soil culture has changed. We do not beg for a hearing; we answer questions. It used to be that men were all the time asking, "Now really is there anything in this theory of farming so as to get good crops in the dry country?" Now they ask, "How do you do it?"

So, you see, the situation is quite different. Men do not now question that there is something in it, a very real and substantial something. What they want to know is how to make practical application of principles which have been shown by the best proof to get results. We do not now engage in arguing that farming can be done in regions where long it was supposed no farming could be done, nor do we have to enter into a joint debate as to whether or not the yield of crops can be enlarged by scientific soil culture. Everybody now admits it, or at least everybody free from prejudice and who knows.

What, then, is this scientific soil culture which is the basis of the wonderful development in the dry regions of the world?

I might say it is very simple and after explaining a few things pass it up; or I might surround it with mystery and say it is so complicated that only experts and men of science can understand it. I might justify either course, but I prefer, if I can, to say something that will aid the plain farmer and lead him into investigations for himself that will enable him to make the most out of his opportunities.

Scientific soil culture is simply a question of disking, plowing, harrowing, packing, and cultivating the soil in such a manner as to be able to utilize the heat, air, water and light and obtain the largest possible yield of the various crops. But, you may say, this is about all there is to farming in any old way.

For the dry country the essential thing is to not waste, or permit the waste of the moisture. My contention has long been that in most of this country and in nearly all seasons we have enough water if only we have not been wasteful and extravagant. This applies to regions that are regarded as very humid. One great trouble has been that many farmers have had all their training in regions where water is free and abundant and they have never had the idea that it may be necessary to conserve the moisture. This is one point which ought to greatly interest every farmer.

While the conservation of the moisture is an important factor it is by no means all. It is only one of many vital things to be carefully considered if we are to reach the high limit of yield in all fields that now seems possible.

The physical or mechanical condition of the soil is the all important factor, as it has more to do with the quantity and quality of the crop

yield than any other one thing. If the seed and root bed is not properly prepared all the after cultivation can not bring the highest yield. No matter how much moisture you have conserved in the soil below or how completely you may keep the weeds out you can not reach the high limit of yield without close and careful attention to the preparation of the soil.

Air is just as necessary an element in the soil as the water, but both must be there in proper quantities. If there is too much air and too little moisture nitrification ceases. If there is too much moisture and too little air the effect is the same. From experience and observation we have concluded that a certain chemical action must be practically continuous in the soil during the growing season if we are to grow the largest crops. This chemical action is unquestionably dependent upon a certain ideal or perfect condition of the soil—a physical condition that will carry in the soil just the ideal quantity of both air and water—and then as soon as the soil becomes sufficiently warm nature's work begins.

The soil mulch is for three purposes—to more readily admit the rain when it comes, to admit of a free circulation of the air into the soil and to prevent the loss of moisture by evaporation.

Sometimes the cultivation is not deep enough or sufficiently frequent and a crust forms at the top of the firm soil underneath the mulch. This crust shuts out the air to a degree and it matters little then how perfect may be the supply of moisture at the roots, for the growth will certainly be checked.

That nitrification is a necessity in the soil during the crop growing season is unquestionably true. If the process of nitrification is going on sufficiently to meet the requirements of the crop this is always evidenced by the dark green and healthy appearance of the plant.

Just a word here in regard to the subject of "summer culture" or "summer tillage" and what it is and what is accomplished by it. In the first place summer culture is not summer fallow. The latter contemplates permitting the field to lie fallow for at least a large part of the season. Summer culture contemplates the working of the field and doing this for a specific purpose. The primary purpose is to secure good tilth of the soil. The incidental purpose is to store the water in the soil. Take as an illustration a field which in the springtime is in only fair condition for a crop season or not in condition at all. There may not be enough moisture or the land may be hard and impossible to work, or it may not be fit for cropping for any one of a dozen reasons. The first thing is to get the surface worked down as best it may be so there will not be a rough surface of large clods. It should not be worked down to a dust surface. Almost certainly there will come some rains in the spring time. If the field is left alone the water soon disappears. A crust forms at the surface and this favors evaporation and shuts out the air. The crust must be broken up and this will stop evaporation and permit the permeation of the air in proper quantities. Perhaps the soil down near the bottom of the furrow is loose and open; if so, it is important that this portion be packed. This, however, should be done at the time of plowing. But a little later another rain falls and another crust is formed, then must the crust again be broken up with the harrow. This is the process of summer culture.

Why all this attention to the soil when there are no crops? You are getting ready for the future. You are storing water which falls this year that you may use it next year or the year after. You are putting the soil into that certain necessary physical condition for the control and utility of air and water that you may enlarge the amount of humus in that soil. You are assisting nature in the chemical processes which lead up to the ideal condition for the seed bed and the increase of available fertility or plant food.

It is very hard for the farmer to believe that he can store the moisture in this way for use at some other time, but it is actually being done, and there is no use arguing with facts. Neither can the average farmer appreciate that certain tillage this year may and if timely and properly

done will increase the crop next year, or that air is vital to the growth of the plant as water but both must be in the soil in proper quantities and properly combined.

The tendency of the moisture is to go downward, if there is enough of it so that the ordinary force of gravity can operate. But it will also soak down into the lower portions of the soil by capillary attraction. Thus the soil will become moistened down several feet deep. There is abundant evidence to prove that by proper working of the surface the moisture content may be affected down five or six feet in some soils. This layer of soil five or six feet is literally the farmer's cistern. It may receive a fresh supply of moisture in July or August or in the middle of winter, and it is just as important that the fresh supply be saved and stored one time as another. Therefore in time of ample moisture prepare for drouth.

As to saving this moisture the soil mulch is the best thing. If there is a heavy crop on the ground the plants will shade the surface and retard evaporation, but of course the roots are sucking up the moisture. If the ground is bare and a crust is formed such as will be formed where the rain has beaten down the dust surface, then evaporation will be very rapid. The farmer should maintain a soil mulch of small particles of soil broken up, this layer to be two or three inches deep. If it is a layer of dust it will either blow away or really aid in the waste of the water. But a mulch of small particles of soil will very largely prevent loss of water by evaporation. At the same time such a mulch will permit the access of air to the soil and thus aid in the chemical processes.

I have given these illustrations of the application of the system so that farmers who actually hold the plow may understand just what can be done. After all, this is only a small part of the whole system. It affects the foundation principles, hence the development of the system leads to a great many new ideas and it covers the whole range of soil cultivation.

I may be permitted a word of reminiscent nature which will aid in an understanding of the principles. It was while I was engaged in farming in South Dakota in 1882 and subsequent years that I was literally forced by reason of the disasters of a drouth to take note of conditions in the dry coun^{try}. One thing which attracted my attention was that in a field where the wheat crop was practically a failure by reason of a prolonged dry spell, there was noticeable a large number of small patches all over the field. Investigation proved that these were where the hoofs of the horses had sunk deep into the soft ground and had so packed the under portion of the ground that moisture was held there. As a result the grain grew strong and fine on these small patches that had been packed down by the horses. Right there I became convinced that there was something in the idea of having the soil packed down where there was danger of loss from drouth. In 1885 I had made, in a small blacksmith shop at Columbia, S. D., the first machine designed especially to pack the under portion of the plowed ground. It was a success insofar as packing the soil was concerned but it was too hard to operate and was abandoned. But the idea of having the soil packed never left me and out of this idea grew the modern soil packer, which is now in use all over the world.

Now, going back to the first two paragraphs of this article, a reason can be found for certain things. In the first place, it is in Nebraska more than in any other state that there is wide dissemination of information as to scientific soil culture. I have myself lectured and addressed hundreds of meetings all over the state and for six or seven years it has been taught and explained by the state institute workers at farmers' institutes in all parts of Nebraska, and I know personally that on many farms there has been for years fairly good application of the principles. Out on the state experiment farm at North Platte scientific soil culture is being tried out in a manner to challenge the attention of the world. A yield of sixty-two bushels of wheat to the acre in 1907 and of sixty-seven bushels per acre last year is a fact not to be passed over lightly. The average yield of wheat in Nebraska is being increased by reason of the use of scientific soil culture methods. We predict the next five years will see another increase in the average yield.

Again, it is certainly true that within the past ten years the area of land actually put under cultivation in the semi-arid region has been enormous. I have had something to do with demonstration farms in a dozen states of