

refractory, it probably shows the absence or a deficiency of humus, shows bad tillage and altogether poor farming. Such a soil as that would require drainage in the first place. Lack of drainage has tended to the puddling of the soil. Its fertility is exceedingly low. It needs, above all things, humus.

Now, what does fertility consist in? By the word fertility I mean crop-producing powers. Does it always depend upon the amount of plant food in the soil? If you look into this question of fertility you will see there are really three factors to consider:—

Firstly, that which is of paramount importance, the percentages of available plant food in the soil.

Secondly, the physical conditions of the soil.

Thirdly, The climatic influences—rainfall, temperature, sunshine, etc.—which you have to take into consideration.

I have been talking so far upon the first of these factors, but will now say a word or two on the other factors, from a practical standpoint, in connection with the renovation or improvement of impoverished soils.

Plants need a loose, mellow, moist, warm soil in order that the seeds in the first place may find a comfortable bed in which to germinate, and afterwards for the roots to penetrate and forage for their food. We know that the large amount of water that is utilized by plants is taken from the soil. A soil must be in good tilth or mechanical condition or it will not hold this soil moisture. Hard, cloddy soil, such as I have described, may be renovated and improved. An analysis of such a soil, I say, shows that it is deficient in humus, that is, deficient in vegetable matter. This is the constituent which gives to soils their black colour; you can always get a very good idea as to the amount of that constituent from the colour or appearance of the soil. Very well; I am supposing this is a heavy clay, plastic when wet, cloddy and hard when dry, and which is deficient in humus. Why should we supply humus? Humus, though of no value in itself, is a storehouse for plant food; it is the great holder of nitrogen; it is the great absorbent of moisture; it is the one constituent which regulates the temperature of the soil, guarding it from extremes of heat and cold; by its decomposition it sets free plant food. The keeping up of the humus of the soil is one of the questions which we have not, until quite recent times, given the consideration it merits. We find that the continuous cropping of the soil, be it clay or be it sand, tends to the reduction year by year of the amount of humus in the soil, and, consequently, it is of the first importance to replace this constituent.

What are the sources of vegetable matter that go to form humus in the soil? When we return vegetable matter to the soil we are returning nitrogen also; the one is the concomitant of the other. The first of these sources available to the farmer is barnyard manure; but the probabilities are that, if you are not keeping very much stock, you will not have a sufficient supply. Suppose you have not; what other sources are available that are not too expensive? I answer, the legumes—the beans, the peas and the clover, which are not only themselves rich in nitrogen, obtained, as we have seen, as a gift from the air, but which, when turned down, will supply a large amount of organic matter that will undergo a gradual decay, furnishing the soil with humus. For several years we have been making experiments in the matter of clover. In the practice of sowing some eight or ten pounds of clover seed with all our grain crops, we find we are adding to that soil as much humus and nitrogen by the turning down of the clover as we should be if we were to supply eight or ten tons of barnyard manure. You can see the value of this for your orchard work. I am not advocating keeping your orchards necessarily covered with a crop all the year round. I am speaking as one having immediate and personal experience in the matter. It is well admitted now, I think, by the majority of good orchardists that the best results are obtained by keeping the surface of the soil cultivated during the dry months of summer, so as to prevent excessive evaporation of the moisture. The keeping of the orchard under continuous crop is a very different thing to the growing of clover during the months of autumn and turning it under in May, a practice which we follow at Ottawa. In this way we have been enabled to build up very poor soil in a few years. I advise you all to try this method in your orchards.

There are other sources of nitrogen available to some of you; there are large deposits of what we call swamp muck, peaty material, which has resulted from the decay of thousands of generations of aquatic plants, preserved there by water. Now that material itself does not contain any nitrogen which is immediately available; it does, however, contain a very large amount of nitrogen which, by the process of fermentation, may be converted into most