BRITISH COLUMBIA

Fruit and Farm Magazine

A Monthly Journal Devoted to the Interests of the Man on the Land.

Vol. X.—No. 6 | Vancouver, British Columbia | [$1.00 per year in Advance

Soil Fertility

With Special Reference to Manure and Fertilizers---Rotation of Crops

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The dwellers of the cities and those living in large industrial centres are sometimes inclined to forget that all the great industries and activities in the world are directly or indirectly dependent upon the soil for their continued existence. Without agriculture—including horticulture, its crowning glory—Canada would be nothing. Even though man does not live by bread alone, yet we must eat to live. The production of foods of various kinds is consequently the fundamental industry; and it will remain so for all time to come.

From a plant producing standpoint the soil has two distinct functions:

1. It must furnish a home for the plant, i.e., a place where the roots can penetrate the earth so as to give a firm stand to the plants—be these grain, forage crops, vegetables, flowers, shrubs or trees.

2. It must furnish plantfood or nourishment for the growth, development and maturing of the plants.

Drainage, the application of lime, the adding of humus, and when practicable the mixing of different kinds of soil, all tend to improve the physical condition of the land, i.e., to better the home of the plant. The addition of fertilizing materials to the soil, or the liberation of corresponding elements from the soil, means an increase of available plant food. None of these objects can be attained where knowledge, thought or deliberate planning are lacking. System is just as essential in economic crop production as it is in any other enterprise, and the cropping system, or the rotation, as it is generally called, determines in a large measure whether we are to be successful or not in the handling of our soils and in the production of our crops.

Soil Fertility and Rotation.

What system should we follow? One that will bring returns, and that will tend not only to maintain the fertility and productive capacity of the land, but that will improve it if possible. Where crops are removed year after year without substitution the soil becomes poorer and poorer, available plant food (N., P., K.,) decreases, and the yields in some cases dwindle to next to nothing.

One often hears prairie farming referred to as a system of mining or robbing the land. While it must be admitted that there is some truth in this assertion, yet we must remember that the special conditions of the prairies favor such a system if not carried too far. Very few people talk about the soil robbing that is practised both east and west of the Prairie Provinces, even here in British Columbia, where there is no occasion or at least no justification for such methods.

We might consider the choice of rotation under the subsequent headings: 1. Interest, capacity and energy of the grower; 2. Capital. 3. Soil and climate. 4. Manure available. 5. Distribution of labor. 6. Market conditions.

The following rotations should be looked upon from the point of view of general principles, not as examples to be taken literally and strictly copied. A system alone is a dead thing. It is the person behind the system who makes a success of his farm or garden by his skilful adherence to or judicious departure from a system which appeals to him. The main idea is to find a rotation, i.e., a succession of crops of alternate character that will suit the aims and fit in with the conditions of soil and climate and appeal to the liking of the individual.

Garden Rotation A.

First year—Potatoes (with fertilizers); after early potatoes, green manure of some kind.

Second year—Corn and tomatoes (with stable manure).

Third year—Peas and beans (with fertilizers).

Fourth year—Cabbage, cauliflower, etc. (with stable manure).

Garden Rotation B.

First year—Clover or some other green manure.

Second year—Cabbage, cauliflower, celery, roots.

Third year—Peas and beans.

Fourth year—Potatoes, beets, carrots.

Fifth year—Corn and tomatoes (seeded down with clover late in summer).

Soil Organisms.

It is not within the scope of this article to dwell upon the mechanical handling of soils. In this connection, however, it is worth remembering that our own work performed with implements and tools of various kinds is a mere nothing in comparison with the work performed by the forces of nature. The action of the various weathering agents, of the water and of the millions of organisms which abound in all well cultivated soils is a thousand times more effective than all our toil. The best we can do is to facilitate the operations of these agencies; in fact our whole endeavor should be to create suitable conditions for these excellent workers in order either to start them working or to keep them at work.

The removal of superfluous water with subsequent entrance of air, the application of lime, humus and plant food, the ploughing and spading, the harrowing and raking of the land, the checking of weeds and the conservation of moisture by thorough cultivation in summer time, all tend to increase the activities of various soil organisms. Most of these are microscopic in size, and some of them—certain bacteria—play an absolutely controlling part in soil fertility because they bring about the decay of the plant residues, and consequent liberation of plant food. In trying to find out how plant food is made in the soil, investigators have confined themselves almost exclusively to the nitrogen, and with good reasons. Chief among these is the prosaic market price, inasmuch as one pound of nitrogen costs us, under average conditions, about three times as much as one pound of phosphoric acid or potash. Moreover, the nitrogen is more easily lost through leaching or by conversion into gas form than the other elements. The soil factory and its workers, the soil organisms, turn out an excellent product. This product, however, is not one individual's work any more than is the finished article in a modern factory. The raw material undergoes several changes and passes through different hands before it is fit to be served in its place on the plant menu. Take, for instance, nitrogen, which undergoes at least three different changes under the manipulation of different sets of bacterial workers. Thus we have one set of bacteria which converts the organic, complex nitrogen into ammonia. This accomplished, another set of bacteria turn the ammonia into nitrates. From this state a new kind of bacterial craftsmen change the nitrites into nitrates, in which form the nitrogen can be assimilated by the plants.

Besides the bacteria referred to above, we have others that will actually liberate nitrogen in gas form and may thus be counted as absolutely destructive. Their action, however, is counter-balanced to a large extent by the activity of the nitrogen-gathering bacteria which live upon the roots of leguminous plants, such as peas, beans, clovers, etc., and are able to collect the free nitrogen of the air. The legumes provide shelter and starch food to the bacteria, and these reciprocate by giving off the valuable nitrogen to their hosts. Then we have also certain bacteria (Azotobacter) living in the soil that are able to fix the free nitrogen of the air directly, and thus to enrich the soil.

Diagram of nitrogen-fixation and liberation in the soil:

Complex nitrogen compounds—By plants: Ammonia, nitrites, nitrates. By nodule bacteria, Azatobacter, etc.: Gaseous, nitrogen.

The bacteria resemble the rest of us, inasmuch as they must eat to live, and it is just possible that the greater part of the effect of manure and fertilizers is in turn dependent upon, or at least closely interrelated with, their capacity for sustaining bacterial life.

Manuring.

We employ manure in order to improve the soil, and particularly to spread a good