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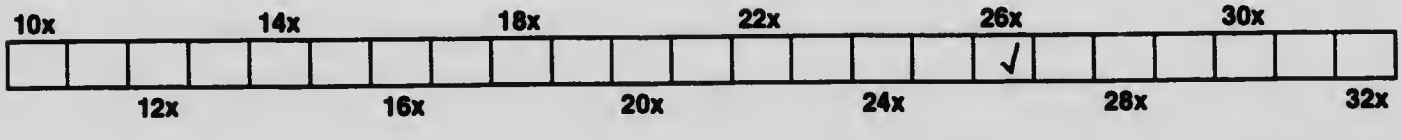

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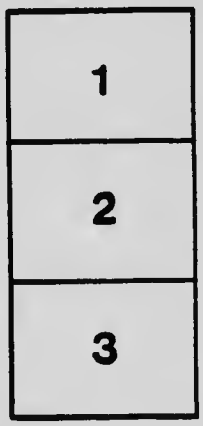

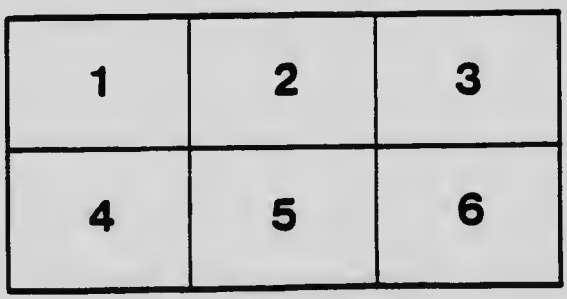

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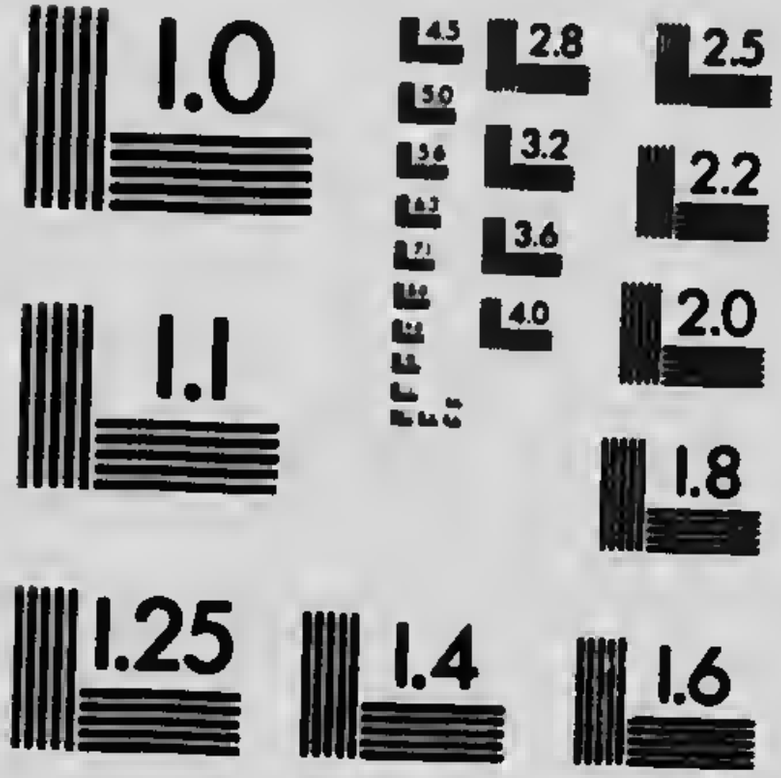

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CIRCULAR No. 5.

PROVINCE OF BRITISH COLUMBIA.

DEPARTMENT OF AGRICULTURE (HORTICULTURAL BRANCH).

PLANT-GROWTH.

By J. F. Carpenter, Assistant Horticulturist.

THE subject deals principally with the physiology of plants. A simple definition of plant-physiology is given by Coulter as "A study of plants at work."

These short courses, besides being of a practical nature, are planned to afford an insight into the underlying principles of orchard and vegetable-gardening work. In order that the horticulturist may carry on his work in an intelligent and systematic manner, it is to his advantage to acquire a "working" knowledge of the structure and growth of plants in its relation to soil-culture, budding, grafting, pruning, etc. In dealing with plant-life we are dealing with living organisms. When the grower has a knowledge of the functions of the different parts of the plant and their conduct under different conditions, he is in a better position to intelligently and economically progress in his work.

In the world there are two main divisions of life—viz., animals and plants. In the animal kingdom classification is made according to differentiation in structure, and there is a variation from animals of very simple structure to those of a high degree of complexity. Such is the case in plant-life. There are classes of plants to be found of very simple structure, such as the Algæ, some of which are single-celled, and classes showing gradually increasing complexity, such as the fungi, mosses, and ferns, until the seed-plants are reached, in which we are most interested, and which show a great differentiation of structure as compared with lower plant-life.

The fruit-grower and vegetable-gardener is interested in nearly all classes of life from an economic standpoint. For example, he is interested in bacteria in their relation to plant-diseases, such as pear-blight; in their relation to the cultivation of the soil, etc., fungi as parasites, such as apple-scab, and in other relations; mosses and ferns in several relations; and seed-plants, such as our orchard trees, in many ways. The seed-plants will receive most attention in this circular.

The fruit-trees and cultivated plants are descendant from wild plants through generations of cross-breeding, selection, improvement, etc., until we have the large variety list of different species of cultivated plants of to-day.

Under natural conditions the whole purpose of our fruit-trees is to live and reproduce their kind. The seed is surrounded by a covering of pulp to ensure its sufficient protection and to attract birds, animals, etc., which aid in its distribution. The amount of pulp necessary for this purpose is small as compared with that which is desired in a commercial fruit. Therefore, in producing a commercial fruit, we require the tree to form an unnatural product—that is, more pulp in proportion to seed than is formed under natural conditions; and as a result we have to surround our fruit-trees with unnatural conditions. Thus follows one of the first principals of fruit-culture, that in order to attain success it is necessary to follow practices which are radically different to those followed in our so-called "neglected" orchards of to-day.

Taking an apple-tree as an example of a seed-plant, it is divided into three main parts—viz., roots, stem, and leaves. A root is situated under the ground and functions in three main ways: (1) Anchoring of plant; (2) storage of plant-food; (3) absorption of liquid plant-food from the soil. The parts of the root that are instrumental in the absorption of plant-food and their conduct under different soil-treatments are of main interest.

It is the small white root-hairs near the terminals of the roots and rootlets that function for this purpose. They cannot take in the solid food as an animal does, but require food in solution. Soil-treatment which is conducive to the solubility of plant-food is discussed in the circular on soil-cultivation. The absorption of liquid plant-food by the root-hair is brought about by osmotic action, by which the presence of the weak solution of plant-food on the outside of the root-hair (the outside layer of which is a permeable membrane) and a strong solution of cell-sap on the inside, the weaker solution will be drawn in by the strong. There are conditions under which this action is reversed—i.e., where the solution on the outside is more concentrated than the cell-sap inside the root-hair—with the result that plasmylosis and death of the cells take place. A good example of this is found in the action of alkali soils on plants.

These root-hairs will not form under very dry soil conditions, neither will they live in water-logged soils or soils devoid of air. Their development is impeded in very compact soils. The relation of this to soil-culture and irrigation is of great importance. Over-irrigated soils are instrumental in causing a diseased condition of the root and its poor [illegible] besides being detrimental to the physical and mechanical cond[illegible]ll and the proper liberation of plant-food. A proper system of [illegible] results in the development of a large root system capable of obtain[illegible] from a large area of soil. Poor cultivation results in weak soil[illegible] plant-food, and thus a waste of water in supplying the plant with the required amount. It also results in a waste of water through evaporation, and a root system will not develop well in a very dry soil. The intimate relation of underdrainage, soil-cultivation, supply of humus and plant-food, proper irrigation methods, etc., to the development of the root system and the economical growth of plants cannot be overestimated.

Root-pruning, both of the old and young tree, root-grafting, etc., can also be discussed in their physiological relation to the plant. The stem and branches of the tree, besides forming the structure on which the fruit and leaves are produced, contain organs for the conduction of food, the growth of the tree, and the storage of plant-food. One of the most important organs from a practical standpoint is the cambium layer, which is the only part of the stem and branches of the tree in which new cells are formed and growth takes place. (When a tree is barked during the rapid growing season it usually separates

at the cambium layer.) The relation of this to the practices of budding, grafting, etc., is most important. The approximate location of the organs for the conduction of plant-food and sap is important in its relation to the ringing of the tree, peeling of the bark, cutting above and below buds etc.

The leaf is one of the most interesting and most essential parts of the tree. It is here that the raw plant-food as it comes from the soil is transformed into carbonydrates, etc., which are used for the growth of the tree and the development of its fruit. Without leaves during the growing season a plant could not live any length of time, as the plant-food, as it is absorbed from the soil, is of little use for the growth of the plant. The outside accessories to the elaboration of plant-food in the leaf are mainly heat, light, and air. Situated on the leaf are numerous breathing pores, which, besides functioning for the taking-in of air, give off by transpiration the excess moisture from the plant-food in the leaf.

The buds for the following season's crop of fruit and leaves are formed in the axil where the petiole of the leaf joins the twigs, branches, etc. The amount of plant-food elaborated in the leaf seems to influence to a large extent the character of the buds; and as light accelerates the building-up of plant-food in the leaf, it is necessary to the formation of good strong buds. The relation of this to the formation of fruit-spurs is evident, for in order to favour their formation low down on the branches, it is necessary, especially in the humid climates, to keep the tree well thinned by pruning, to allow plenty of light to reach the parts where fruit is desired. A knowledge of the functions of the leaf are important to the fruit-grower in its relation to pruning, fruit-bud formation, maturity of wood, etc.

The structure of the blossom, formation of fruit and seeds, changes in fruit and vegetables in storage, can be discussed under the heading of "plant-physiology," but owing to the limited space are only mentioned here.

A study of plant-growth is of great interest and value to the fruit-grower, as it is related, either directly or indirectly, to all operations in the orchard. The subject might appear at a casual glance to be too scientific for the practical horticulturist to listen to, but with the man who is interested in his orchard we have not found this to be the case. On the other hand, the subject offers, when discussed from the fruit-grower's standpoint (there are readable books to be had on the subject), interesting and useful information, which will place him in a better position to carry on his operations with pleasure and profit. We trust that the information as given here will be the means of interesting some fruit-growers to the extent that they will secure some available books on the subject, and make use of them as opportunity offers.

Victoria, B.C., December, 1912.

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