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## The Principles of Plant Breeding\*

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**T**HIS is a large subject nowadays. The last seven years have been "fat" years for the student of plant and animal breeding, and it is almost impossible to keep up with the tremendous strides that are being taken by hundreds of scientific investigators both in America and Europe. Every morning we enquire what new discovery was made the day before, lest we overlook some important advance and fall behind in the onward march of the times.

On account of the recent discovery of some of the fundamental principles of heredity the plant breeder is now able to work with some degree of certainty in the production of new forms of plants. The haphazard guess-work of former days is to some extent replaced by definiteness, and "the breeder may proceed to build up synthetically, character by character, the plant which he requires. His chief limitations will be those imposed by Nature upon the variations of living forms."—(Punnett.)

It is my purpose to discuss the newer aspects of plant breeding, not from the standpoint of a practical plant breeder, but rather from the standpoint of the biologist who is interested primarily in the principles that underlie scientific plant breeding. In the time at my disposal it is impossible to deal at all fully even with the principles of plant breeding, inasmuch as each of the main methods of plant improvement is now regulated by certain principles of its own. The ideas of "elementary species" and "mutations" belong distinctly to the twentieth century; hence they are not yet out of their infancy stage, and no one is bold enough to state how far-reaching the influences of the new ideas may be. Already in many quarters Darwin's explanation of the process of evolution is being superseded by that offered by De Vries in his theory of mutations. It is becoming more and more evident that the principles underlying plant breeding are closely connected with the question of the origin of species and of evolution.

Plant breeding may be defined as "the intentional production and perpetuation

of desirable varieties of cultivated plants." The three main methods now in use for the improvement of plants are: 1. Continued selection of superior individual plants; 2. Separation from mixtures of such individuals as show desirable qualities, and at the same time breed true to type; 3. Combination of the desirable qualities of two strains or varieties by hybridization.

It is plain that all three methods cannot be employed in every case of plant improvement. For example, some plants are propagated by buds; the crossing of two varieties or strains to form desirable hybrids is a process too difficult and too involved for any person but the trained plant breeder; and, lastly, the separation of new and desirable elementary species requires such

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—H. J. Snelgrove, President, Ontario Horticultural Association.

careful observation of a refined order that the average man untrained along this particular line will seldom meet with success.

#### SELECTION

The improvement of plants by the continued selection of superior individual plants has been in vogue since Roman times. Virgil, for example, in his "Georgics," wrote: "The chosen seed improved through years and labor was seen to run back, unless man selected by hand yearly the largest and fullest ears." It is probable, therefore, that our chief cereals have been kept up to a high standard of excellence through all the centuries, by a strict process of selection. The origin of most of our horticultural fruit-producing plants is extremely uncertain, being lost in the mists of antiquity.

The importance and value of selection lies in the fact that plants as a rule are highly variable. It is a common matter of observation that plants produced from seed obtained from the same parent may vary more or less widely in size, shape

and other characters. Some of the plants will be inferior from an economic standpoint, others will be superior, but the majority will be about the normal. Experience tells us also that if the seeds from a superior plant be sown, the majority of the new individuals that arise from the seeds will show themselves to be superior. In some cases, therefore, the desirable variations are transmitted to the progeny, and by continued selection of the best seeds from the best plants the plant grower can obtain a higher yielding strain of superior quality. However, in order to keep the strain up to this high standard it is necessary to continue the selection year after year, for unless this is done the plants gradually revert to the normal or average of the strain before selection began.

It is by adoption of this plan of selection that the Canadian Seed Growers' Association hopes to increase the crop yield of Canada. Although there seems to be a limit to the improvement effected by selection of this kind, (i. e., that improvement cannot continue indefinitely, but has a maximum limit) yet the general adoption of this principle of selection of the best seed from the best plants will greatly increase the value of the crops of the country.

Sometimes it is possible to force variation in plants which are but slightly variable by changing the conditions surrounding the plants. For example, it has been observed that high cultivation and manuring will often cause plants to vary considerably, so that the plant breeder is in a better position to make his selections. Budding, grafting and vegetative propagation also tend to bring about variations from which the breeder may begin his selection.

There are two methods of growing plants for selection, which Webber calls the "Nursery Method" and the "Field Method." By the nursery method "each plant is grown under the most favorable conditions for its best development." By the field method "the selections are made from plants grown under normal field conditions." Both methods are in general use by plant breeders, but the nursery method requires more care and attention than the ordinary breeder would care to give to the work.

Part of an address delivered before last convention of the Quebec Pomological Society. The next instalment will deal with the separation of mutations that have desirable qualities. The third instalment will discuss the question of hybridization.