PROSPECTS FOR SELECTION OF SUNFLOWER MODEL CHARACTERS

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Sunflower is one of the youngest cultivated plants, being introduced as an oil crop in Russia late in the nineteenth century. For this reason the care to improve this plant is of relatively recent date and scientific sunflower breeding, initially based on the indigenous strains bred by popular selection, was initiated before World War I.

In a first stage, which can be considered the stage of the development of varieties with a high oil content, the conventional breeding methods have been successfully employed, and especially the method of individual recurrent selection with progeny testing and controlled pollination of the best families used by V. S. Pustovoit at Krasnodar. Concurrently with the enhancement of yielding capacity and oil content, attention was also paid to improving the main morphological and physiological characteristicis. But, notwithstanding all these efforts, it has not yet been possible to arrive at a superior type of sunflower well enough adapted to the intensive agriculture of our days, able to produce high and constant yields under different environmental conditions.

Modern sunflower breeding is particularly associated with the utilization of heterosis in the production of superior F_1 hybrids. Apart from the wellknown advantages, connected mainly with the possibility of improving substantially the seed and oil yield and plant uniformity, this method has proven very efficient in breeding for disease resistance, direction in which sunflower high oil varieties are deficient.

Unlike conventional breeding methods, the F_1 hybrid method fecilitates the construction of a morphological and physiological ideotype of sunflower, i.e. a model plant which may be expected to yield a greater quantity or quality of seed and oil in a defined environment. It should be possible to improve and introduce into the general ideotype the individual model characters and thus develop a new type of cultivar.

The main attributes of the ideotype are morphological characters, but they are based on physiological considerations. There is an important variation of these characteurs in sunflower populations and by self pollination and selction such a variability is considerably increased.

During selfing and inbred selection, various phenotypes appear which could be the starting point for selection of model characters. Exemples in this regard are numerous. Thus, very tall or very short inbreds can be selected from an initial open-pollinated population as well as a range of intermediate forms, if selection is done primarily in such a direction. Variation in head bending could go from the upright position to the excessive bending, depending on the head weight and stem thickness and resistance in its upper part. The size and the number of leaves are also characters with great amplitude of variation. Inbred lines could be developed with a certain disposition of leaves, from the horziontal to the erect position, with long or short petiole, with smooth or goffered limb, depending on the proposed architecture of the foliage.

Head size is a character which can be modelled in correlation with the large number of seeds, their compactness and particularly the fertility of the central zone of the head.

Certain model characters, especially those emerging from physiological studies, are more difficult to bred, because of the sporadic confrontation of the respective phenotypes with the environmental conditions. Thus, using the selfing method, one can develop inbred lines homozygous for lodging resistance, a phenomenon caused by the dislocation of a shallow root system. In breeding nurseries sunflower lodging could be noticed only in years with

heavy rains and storms occuring in the second half of the growing season.

Selection for tolerance to crowding among plants of like genotype must be correlated with the capacity to develop a large and compact head and therefore a high yield per plant in the absence of competition from neighbours. This capacity of such genotypes to yield in a community can be analyzed by testing their reaction to high and low population densities, which complicate selection works.

Lack of photoperiod reaction is a model character which can be selected by testing a large range of inbreds under short and long day-light in phytotron conditions. Although in a low proportion, such inbred can be found in sunflower germplasm collections and could be used in breeding phenotipically stable hybrids with greater ecological adaptability.

A promising selection, though more difficult, could also be performed and in respect of the enhanced effectiveness of photosynthesis by developing a special genotype of high net assimilation rate or with a particular pattern of deployment of photosynthates. Assuming that the model is capable to yield high quantity of dry matter (net photosynthesis), another characteristics must be its capacity to transform a maximum part of that yield in useful production. A high harvest index could be achieved by selecting for a longer seed filling period and a shorter period from emergenge to flowering.

Other important characters such as disease resistance and maturity, can be easier incorporated into the new cultivar, according to local circumstances.

Because of the unpredictability with which genes controlling the model characters may affect other characters, the incorporation of the individual model characters must be done on the basis of the adequate study of genetic corellations and dominance relations existing in F_1. For this reason, the selection of model characters should be the result of both physiologic and genetic investigations, and the designed ideotype must finally be subjected to rigorous selection for yielding capacity and good adaptability to a large range of environmental situations. Such a complex and laborious task can be solved by a closer co-operation among geneticists, breeders and physiologists from those countries interested in sunflower crop development, as it is already envisaged by the Research Network on Sunflower sponsored by F.A.O.