SOURCES OF RESISTANCE 1)

J. C. DORST
Institute of Agricultural Plant Breeding, Wageningen
Received 20 July 1960

ABSTRACT

In the course of ages and under widely different conditions nature, through mutation, spontaneous crossing and natural selection, has presented mankind with a great wealth of material.

After mentioning the source of resistance for many cases the writer has grouped them into the categories existing varieties, land races and gene centres.

In former years taxonomists searched for new species to collect them for herbariums, nowadays living collections are planted. Plant breeders now are hunting for new valuable genes.

INTRODUCTION

Those who have read PAUL DE KRUIF'S book "Hunger Fighters" (2) will undoubtedly remember the name of the "wheat hunter" CARLETON who in Southwest Siberia searched for wheat varieties that were able to stand the dry warm summers of some parts of North America. In Russia he searched for winter wheats being able to survive under very low temperatures and bare frost.

The spring wheat Kubanka and the winter wheat Kharkof introduced by CARLETON have been widely grown in North America and although their introduction took place as far back as 1900, these varieties are still grown there.

Thus in Russia and Siberia CARLETON searched in regions with a climate similar to that of wide areas in North America. Drought, heat, cold and storms will have occurred in various degrees and from year to year, but the resistance of Kubanka and Kharkof against unfavourable weather was a permanent guarantee that these varieties could be grown without too great risks. It should be mentioned here that also some valuable oat varieties in North-America are of Russian origin.

SOURCES OF RESISTANCE AGAINST ABIOTIC FACTORS

To obtain material with resistance against abiotic factors, in general search should be made in regions where some unfavourable factor occurs frequently and/or to a high degree. In this connection I may refer to low temperatures, high temperatures, drought, low or high pH, salt content of the soil, etc. Yet it must not be forgotten that such forms of resistance are often very relative, since in their effects they are highly dependent on the development of the plant and on the conditions prevalent before, during and after the "affliction". A given wheat variety may be able to stand 15°C of frost as the case may be and die with 5°C frost in another case.

1) Lecture read at the A-course "Resistance in agriculture", 12-14 Jan. 1959, organised by the Royal Society of Agricultural Science and the Netherlands Society of Graduates in Agriculture at Wageningen.
J. C. DORST

For a plant breeder it is of great importance to know that some resistance is often more or less linked with other characters. For instance in the West-European wheat varieties cold resistance is linked with great cold requirement and slow spring development. However, slow spring development is generally considered as an obstacle for obtaining maximal production. It has been found that some Canadian spring wheats combine a good cold resistance with a rapid spring development. In some Russian spring wheats also this combination of characters occurs. And so we see the paradoxal phenomenon that now Canadian spring wheat varieties are utilized in attempts to enhance the cold resistance of Dutch winter wheat, although it is not a question of extremely low temperatures. As a matter of fact resistance in agriculture is of importance only when it is combined with many other properties suitable for the purpose and the conditions under which the crop is grown. In many cases the introduction of some resistance into existing varieties will present more difficulties when the soil, the climate and the cultural measures in the land of origin deviate more from those of the land of introduction. Therefore we shall have to await whether the Canadian spring wheat varieties mentioned above will cause unpleasant experiences as concerns straw stiffness and susceptibility to some diseases. Theoretically it is easy to obviate such difficulties by backcrossing, or repeated backcrossing; in practice it is often not so simple.

SOURCES OF RESISTANCE AGAINST BIOTIC FACTORS

In resistance to biotic factors two living organisms are involved. The host plant as well as the parasite may be variable genetically, which offers selection possibilities for both. New forms may arise by mutation and crossing. The chance that a group of plants which is indicated as variety will change considerably through these agencies is very small and in some cases even excluded. Contrarily the threat of new dangerous physiologic races of the parasite is always there, while also the chance of transference or increase of existing forms must not be underestimated.

The occurrence of new physiologic races has roused pessimism in some circles: all the so-called resistant varieties would lose their value after a shorter or longer time because of adaptation of the parasite. In this connection the Jonquois and Heine VII wheats may be mentioned, two varieties which were very severely attacked by yellow rust a few years after their introduction in the Netherlands. On the other hand there are also varieties which were grown for years without being damaged: Wilhelmina wheat has been a leading variety for over 40 years in the Netherlands, Juliana for more than 30 years. They did not disappear because of diseases, but because other varieties yielded more. The question arises now whether these varieties might be used as sources of resistance.

Some physiologic races of parasites occur only locally. Material introduced from elsewhere sometimes appears to be susceptible to diseases which in the land of origin do not occur or if so, only sporadically occur, and for which no selection has taken place neither by man nor by nature. All this means that new material which has the name of being resistant should be tested accurately and in addition that it is of prime importance to know something of the other characters.

When sources of resistance are searched they are close at hand for some diseases, but for others we must cover wide geographical distances or overcome remote taxonomic