GENETICAL DIFFERENCES IN THE SENSITIVITY TO 2,4-D HERBICIDE*

by

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Herbicides of the auxin-type exert a more or less selective toxic action on some plant species whereas other plants are not affected or are even stimulated to some extent. The most widely applied and most thoroughly studied member of this group of compounds is 2,4-dichlorophenoxyacetic acid, briefly 2,4-D, the herbicidal action of which is restricted in general to dicotyledonous plants. Its selectivity depends on the possibility of penetration, on the speed of translocation and also on the physiological conditions of the plants — such as age, nutrition, assimilation of light etc. The most interesting problem is, however, the relation of selective toxicity to the differences in plasmatic resistance, which is probably due to some manner to the differences of the stability of lipoproteid membranes (F a l u d i 1962).

In the studies on plasmatic resistance to herbicides, in order to eliminate the effect of several factors, mostly parts of the hypocotyl or coleoptile of young seedlings, or leaf portions are usually applied. These investigations revealed differences in the plasmatic resistance which might reach several orders of magnitude. In detailed investigations it was shown that marked differences in sensitivity might exist among mono-or dicotyledonous plants as well.

Recently the method of tissue culture is sometimes applied to the study of growth substances. The growth substances are added to the culture medium; the conditions of such experiments are well defined and controlled. We found in our experiments that under such conditions even very slight differences in plasmatic resistance can be detected (N e w c o m b et al. 1957).

It has been found that the explanted tissue portions of various potato varieties grow differently on 2,4-D containing synthetic media. From the differences in growth rate, conclusions can be drawn as to the different sensitivity to 2,4-D of the varieties tested. The knowledge of these differences might contribute to the development of breeding work aimed at decreasing 2,4-D sensitivity of cultivated plants as compared to the sensitivity of weeds.

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Twelve potato varieties were compared in tissue culture as to growth in the presence of 2,4-D. The initial weight of the explanted tissue portions was 22,5 mg. The concentration of 2,4-D added to the medium 10^{-4} M. The growth habit of the cultures was registrated after forteen days by photography. The growth pattern of the cultures prepared from there five potato varieties is shown in Fig. 1.

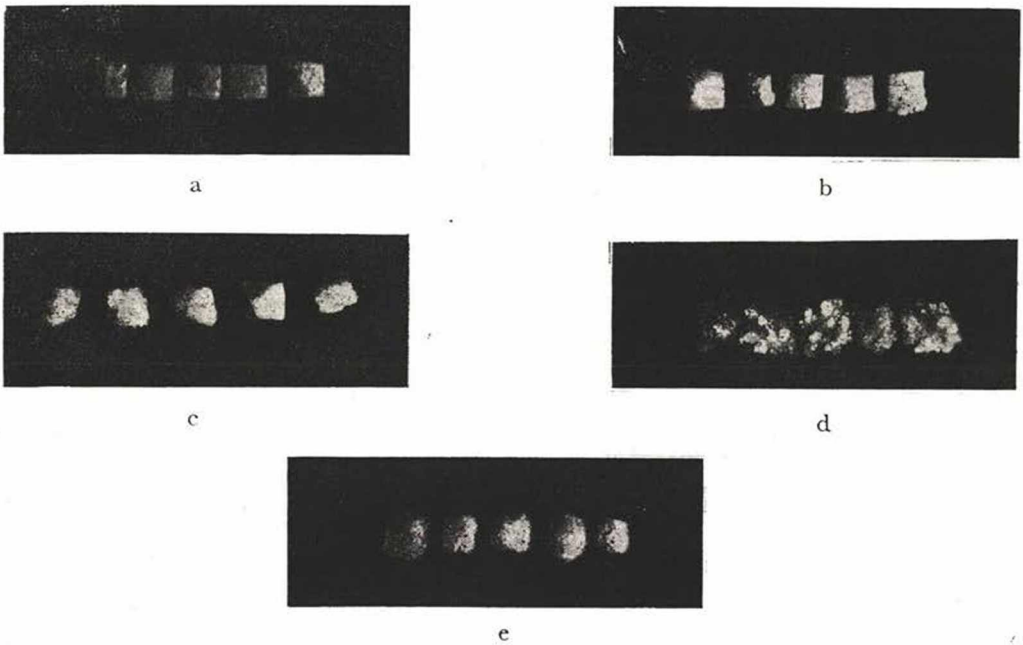

Fig. 1. Average weight of the five two weeks old tissues (in mg)
a = Margit 23 ± 11,1 mg *b* = Aquila 25 ± 11,4 mg
c = Ella 27 ± 12,6 mg *d* = Delta 39 ± 16,4 mg
e = Gül Baba 81 ± 5,4 mg

From the 12, five varieties were chosen for more detailed, quantitative investigations growing at the lowest and highest rate, and others representing intermediary types.

These varieties and the average weight of the two week old tissue cultures were the following

Margit	23 ± 11,1 mg	Aquila	25 ± 11,4 mg
Ella	37 ± 12,6 mg	Delta	39 ± 16,4 mg
		Gül Baba	81 ± 5,4 mg

The growth pattern of the cultures prepared from these five potato varieties is shown on Fig. 1.

To assess the quantitative growth characteristics tissue cultures were prepared in three series with 240 tissue pieces from each of the varieties. The weight of the tissues was determined after 14 days by a torsion balance.

The results obtained were subjected to an analysis of variance. The data are shown in Table 1.

Table 1.

Analysis of variance of the fresh weight of tissue cultures of various potato varieties

The source of variance	$(x-\bar{x})^2$	D. f.	s^2	F
Total	791 087	1199	660	5,19
Error	140 095	1106	127	–
Differences between the varieties	528 863	4	132 216	1041,97
Differences between the series	27 017	2	13 508	106,36
Individuel differences within the species	658 216	74	8 895	70,03
Difference of the tissue pieces prepared from the same tuber	158 943	15	10 596	83,43

It may be seen from the Table that the differences between the varieties are most explicit. The F-value of the individuals belonging to the same variety is smaller by about an order of magnitue and it is essentially identical with the F-values of the various series and of tissues deriving from the same tuber.

From this the conclusion might be drawn that the method applied is suitable for the indication of plasmatic resistance of potato varieties to 2,4-D. By contrast, the method is less suitable for the demonstration of intravarietal differences, due to the fairly great differences between the tissue pieces deriving from the same tuber. Nevertheless, it seems very likely that there are no major individual differences within the varieties studied as the value of the scattering of the various series is more or less the same, as shown previously (Fig. 1.).

The objection might be raised that the varieties which respond poorly to 2,4-D, require perhaps some special growth factors for their growth which were not found in the nutrient medium. The probability of this is rather slight in this case, because one would expect the growth to start from endogenous reserves and to slow down later when the endogenous growth factors have already been utilized. According to our observations the situation is just the reverse. We have found that the tissues, which respond poorly to 2,4-D, start to grow after a long *lag* period, sometimes after several weeks.

From the results presented we came to the conclusion that clonal selection for 2,4-D resistance has no major chances with the varieties investigated. In breeding for 2,4-D resistance the method of hybridization and progeny tests have better perspectives.

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