NOTES ON THE INHERITANCE OF FIELD RESISTANCE OF THE FOLIAGE OF SOLANUM TUBEROSUM TO PHYTOPHTHORA INFESTANS

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ABSTRACT

During the very wet summer of 1956 observations were made on the damage done to the foliage by *Phytophthora infestans* in about 2,000 small seedling-clones of 35 cross-combinations. In part of these crosses the genes *R₁* and *R₃* for hypersensitivity were involved.

The degree of field resistance of the material devoid of *R*-genes seems to be governed by a series of minor genes and it is difficult to draw a clear-cut conclusion as to dominance relations.

The *R*-material did not show any lesion during the initial stage of development of the epidemic. However, with the rapid growth of the population of the parasite physiologic races came to the fore and ultimately also the *R*-material was more or less heavily attacked.

The data indicate that the degree of field resistance of the *R*-clones to the new biotype is also governed by a set of minor genes and probably by the same set as present in the material devoid of *R*-genes. As with the common varieties, in the *R*-material there is also a close relation between earliness and a low degree of field resistance. The value of the complex of genes for field resistance that may be present in the wild Mexican species and notably in *S. demissum* is discussed. Finally the influence of the plasticity of the *Phytophthora* population is considered.

INTRODUCTION

In the year 1956, 35 cross-combinations consisting of 20-100 *F₁*-clones of three plants each were grown on a heavy clay soil near the Institute of Agricultural Plant Breeding at Wageningen.

Originally this material was planted to provide tubers for studying in rough outline the heredity of cooking and frying quality. However, the summer was extremely rainy and the tubers were so heavily attacked by *Phytophthora infestans* that of many crosses a few reasonable samples only could be harvested and for that reason the programme had to be abandoned.

It was realized that the severe epidemic offered a unique opportunity for a study of the inheritance of field resistance to *Phytophthora infestans* of the leaves¹) as well as of the tubers.

¹) Field resistance, according to the definition of Black (1), is taken to include all forms of inherent resistance that plants may possess with the exception of hypersensitivity as controlled by *R*-genes.
The presence everywhere in the field of plants of the control varieties Eigenheimer and Climax which both are very susceptible in the leaves, guaranteed the shedding of large quantities of inoculum for a considerable and continuously rainy period. Therefore the conditions for a uniform and heavy attack of tubers and leaves were amply fulfilled.

In part of the crosses the genes \( R_1 \) or \( R_3 \) for hypersensitivity were involved and consequently there was an opportunity to study their effect in rough outline.

In this publication the resistance of the foliage is treated.

**PRESENTATION OF DATA**

The notes on the damage done to the foliage were made from 5–15 August according to the following scale:

- **0** = no single lesion observed,
- **1** = some lesions found on close inspection,
- **2** = some lesions observed on superficial inspection,
- **3** = many leaves attacked but as a general impression the plant is still green,
- **4** = some green leaves left at the top of the vines only,
- **5** = stalks and foliage completely destroyed.

In table 1 the data are presented as far as concerns crosses in which no hypersensitivity genes (\( R \)) are involved. The degree of field resistance of the parent-varieties is indicated according to a scale ranging from 1 to 10 (susceptible to resistant) used in the Dutch Official List of Varieties and by Hogen Esch and Zingstra (5).

At the time the notes were made the susceptible varieties with field resistance 3, 4 and 5 were completely killed (5), the damage done to the moderately resistant varieties (6 and 7) could be evaluated at 4 or sometimes at 3. The highly resistant material (8) in most cases had lost half of its leaves (3) whilst less damage (2) was done to some of them.

The field resistance of all parent varieties is well known and based on many years observations on numerous experimental plots. The G-clones, however, are rather young seedlings, but one cannot be far wrong if on an average their resistance is estimated at 8, as they are derived from the cross Noordeling (8) x Libertas (8).

For the crosses in which the genes \( R_1 \) and \( R_3 \) are involved, the data are presented in table 2. They need to be considered against the background of the interaction between field resistance and hypersensitivity and the development in the field of a population of sporangia capable of attacking the leaves of the hypersensitive plants.

**DISCUSSION**

Although the parents of the crosses were not chosen for the purpose of studying the inheritance of field resistance, there is enough variation in the parental combinations to draw some conclusions of a very general nature.

In the first place our attention is drawn to the data of table 1.

In this material no \( R \)-genes are involved and the field resistance is not obscured by the occurrence of hypersensitive seedlings. It appears that: