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Selection of first-year potato seedlings for resistance to potato leaf roll virus

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Summary

In families obtained from crossing pairs of parents with high resistance to potato leaf roll virus (PLRV), individual clones differ greatly in their level of resistance. Inoculation of first-year seedlings was effective in selecting more resistant families, but it was not so effective in selecting more resistant individual clones.

Introduction

Many authors (Świeżyński, 1952; Baerecke, 1956; Butkiewicz & Dziewońska, 1957; MacKinnon, 1967; Dziewońska & Pochitonow, 1971; Jones, 1977; Ross, 1977; Chuquillanqui & Jones, 1980) have used artificial inoculation of young potato seedlings with PLRV as an aid to selecting in breeding programmes. However in their reports no proof is given as to whether such inoculation helps or not to eliminate clones susceptible to PLRV. Hamann et al. (1968), who examined this problem, found that screening seedlings did not increase the number of resistant clones in the next vegetative progeny. We therefore attempted to obtain more data about the effects of screening first-year seedlings.

Materials and methods

Seed for sowing was obtained from crosses between pairs of clones with high resistance to PLRV. The experiments ran in two series. In the first series (in 1970 and 1971) there were 240 clones originating from 4 crosses, and in the second series (in 1973 and 1974) there were 419 clones, originating from 3 crosses.

When the young seedlings had produced five leaves, in each of them the upper part of the stem was severed and rooted so that each seedling was them represented by two plants – A, the cut and rooted stem, B, the original plant. In this way from each cross two groups with identical genotypes were obtained. There were 51 to 157 completely tested clones from individual crosses (Table 1). Plants of the groups A were inoculated with PLRV in the first year of experiment (as first-year seedlings), and plants of the groups B in the next year (as first-tuber progeny).

The inoculation with PLRV of groups A was done immediately after rooting, when plantlets began to grow. On each seedling 7 viruliferous aphids *(Myzus persicae)* were

Table 1. Origin of the analysed families.

♀ × ♂
First series 1970–1971
1. 66 L 156 × Apta
2. 67 L 9 × 67 L 95
3. 67 L 171 × 66 L 127
4. 64 L 94 × 62 L 1663
Second series 1973–1974
5. Apta × 66 L 126
6. Apta × 67 L 232
7. Apta × 67 L 261

placed with a fine paint brush. The insecticide Metasystox was applied after three days of exposure to kill the aphids.

Ten plants of each clone of group B were grown. The plants originated from rooted sprouts which had been cut from the tubers with ca. 8 g of parenchyma. For inoculation with PLRV, 7–10 viruliferous aphids were placed on each plant being in the first-leaflet stage. After 5 days the aphids were destroyed with Metasystox.

The infection in both groups was estimated on the basis of symptom appearance in the year of inoculation and during tuber indexing. Plants of group A were grouped in two classes – 'infected' and 'uninfected'. The clones of group B were grouped in 11 classes (0.1 . . . 10 of infected plants) according to the number of infected plants.

Results

There was a general conformity in arrangement of families according to level of infection with PLRV in both series independently from stage of plant inoculation, i.e. wether

Table 2. Comparison of data obtained by inoculation with PLRV of first-year seedlings and of first-tuber progenies.

Family	A (first-year seedlings)		B (first-tuber progenies)		χ^2 independence test
	number of inoculated plants	infected plants (%)	number of inoculated plants	infected plants (%)	
First series					
4	55	40	550	46	
1	68	44	680	43	
2	66	50	660	58	
3	51	61	510	57	0.75 P = 0.85
Second series					
5	107	34	1070	17	
6	157	39	1570	23	
7	155	50	1550	24	0.70 P = 0.70

inoculation was done in the stage of first-year seedlings (A) or in the stage of first-tuber progenies (B) (Table 2).

Large differences were observed in reaction to PLRV of particular clones in groups B within individual crosses. In each of evaluated families some clones were not infected with the virus, as well as the others become completely infected.

To estimate the efficiency of evaluating the resistance to PLRV of individual clones as first-year seedlings, the results of inoculating clones from group B were compared with the inoculation results for group A. Table 3 presents the distribution in infection classes of clones from group B in relation to results obtained in group A. The analysis of variance did not show significant differences in clone reaction of group B when compared with corresponding elements of group A.

Discussion

We confirm the conclusion of Hamann et al. (1968), and Chuquillanqui & Jones (1980), that inoculation of young first-year seedlings with PLRV may be useful for select families with higher frequency of clones with higher resistance to this virus.

In view of previous results (Butkiewicz, 1981) great differences in the degree of infection of individual clones cannot be the results of chance variation. It follows that in progenies obtained from crossing of two varieties resistant to PLRV, large genetic variation in the level of resistance of individual clones may be found. This is an indication that (1) we are far from reaching homozygosity in our PLRV-resistant clones, (2) in screening families from crosses between two resistant parents of the type used in the present study not very precise methods of seletion are necessary.

In view of the very poor conformity between infection of first-tuber progenies and first-year seedlings and after taking into account also the large genetic differences, difficulties with screening young first-year seedlings cannot alone be caused by the fact that single plants were evaluated, an explanation suggested by Hamann et al. (1968) to

Table 3. Classification of tested clones according to PLRV infection results obtained in groups A and B.*

Groups A	Groups B: % of clones frequency in infection classes											Number of tested clones
	0	1	2	3	4	5	6	7	8	9	10	
First series												
uninfected	8.6	7.3	12.9	14.5	8.9	5.6	8.9	8.9	6.5	9.7	8.1	124
infected	11.2	9.5	7.8	3.4	6.0	9.5	7.7	8.6	10.3	10.3	15.4	116
$\bar{x}$	10.0	8.3	10.4	9.2	7.5	7.5	8.3	8.7	8.3	10.0	11.7	
Second series												
uninfected	43.0	15.5	13.9	9.8	6.1	5.3	2.0	1.6	0.4	0.8	1.6	245
infected	26.4	13.2	21.3	5.7	10.2	10.9	1.1	1.7	3.4	2.9	2.3	174
$\bar{x}$	36.0	14.6	17.0	8.1	8.1	7.6	1.7	1.7	1.7	1.7	1.7	

* A = clones inoculated with PLRV as first-year seedlings; B = clones inoculated with PLRV as first-tuber progenies (10 plants/clone).
$\bar{x}$ = true (weighted) means

explain their findings. The comparison of the reaction of single plants taken at random from ten inoculated plants of the first-tuber progenies with the reaction of the rest (unpublished data) indicated that the frequency of less infected clones was evidently higher in the group of uninfected single plants than in the group of infected ones.

In our experiments the low conformity may be due to the inoculation of plants treated in an unusual way (cutting and rooting). However, Hamann obtained similar results when he inoculated normally grown young first-year seedlings.

As long as big genetic differences exist in screened material it seems useful to look farther for ways to screen first-year seedlings more effectively. Perhaps very young plantlets in the cotyledon stage or much older ones should be inoculated or still other ways sought for treating first-year seedlings.

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