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The multiplication of three pathotypes of the potato root eelworm on different potato varieties

H. DEN OUDEN

Institute of Phytopathological Research, Wageningen

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Abstract

In two pot experiments the pathotypes, AB and ABCD of *Heterodera rostochiensis* multiplied at lower rates on the potato variety 'Libertas' than pathotype A. Pathotype ABCD multiplied at the same rate on a variety resistant against pathotype A as pathotype A on 'Libertas'. Pathotype AB multiplied at a lower rate on Libertas and a variety resistant against A than A on 'Libertas'. In a third experiment with the pathotypes A and ABCD and five potato varieties susceptible to all pathotypes, two varieties resistant to A and AB and three resistant to A significant differences between the rate of reproduction of the same pathotype on different susceptible varieties were found. The rate of reproduction of the pathotype ABCD on the varieties tested tended to be slightly lower than that of pathotype A on varieties susceptible to that pathotype.

Introduction

In the Netherlands, the greatly increased use of potato varieties resistant to pathotype A of *Heterodera rostochiensis* has resulted in a relative increase of densities of other pathotypes particularly AB and ABCD in the field.

To control *Heterodera rostochiensis*, population increase on a susceptible potato variety must be balanced by crop rotation, chemical control and/or growing resistant potatoes. The amount of control necessary is determined by the rate of multiplication on the susceptible potato variety. Substantial differences in rates of multiplication between potato varieties and pathotypes would require an adaptation of control measures. Kort (1966) found differences between the rates of reproduction of the pathotype A, AB, ABC and ABCD on 14 varieties. However, there were differences in the age and origin of the cysts used as inoculum (Kort, personal communication) and therefore these differences can be due to either differences between varieties or differences in the inoculum other than nematode pathotype.

As potato growing in the future is threatened most by the occurrence of pathotype ABCD, the multiplication of this pathotype was compared with that of the others in two experiments on one *Solanum tuberosum* variety and one *S. andigenum* hybrid, and also compared with pathotype A only in a third experiment on five *S. tuberosum* varieties.

Materials and methods

In 1963 and 1964 two populations, one consisting mainly of pathotypes AB and the other ABCD were propagated on *Solanum andigenum* and *S. verneï* hybrids respec-

tively. In the summer of 1965 these populations and a pathotype A population, were multiplied on 'Libertas' under the same conditions and used in the 1966 and 1967 experiments. In 1969 the populations of pathotype A and ABCD were propagated under similar conditions on the *Solanum tuberosum* variety 'Maritta' and used for the 1972 experiment. In a hatching test equal hatches of eggs were obtained in both populations. The population of pathotype ABCD used appeared to have a much higher rate of reproduction on 'Proton' than other populations of this pathotype (Kort and Huysman, personal communication).

The experiments were done in 2 l pots as described by Seinhorst (1967) containing a mixture of silver sand (60%), clay (10%) and crushed clay pottery with particle diameters 0.05 to 2 mm (30%). To this mixture about 8% (by weight) water and 1 g of an NPK fertilizer (12–10–8) per kg were added. Two kg lots were inoculated separately by adding 10 ml of water containing the numbers of *H. rostochiensis* eggs required to give three population densities. These were 0.3, 1.2 and 4.8 eggs per g of

Fig. 1. The multiplication of three pathotypes of *Heterodera rostochiensis* on three potato varieties in 1966, P_i and P_f are initial and final density (eggs per 10 g of soil).

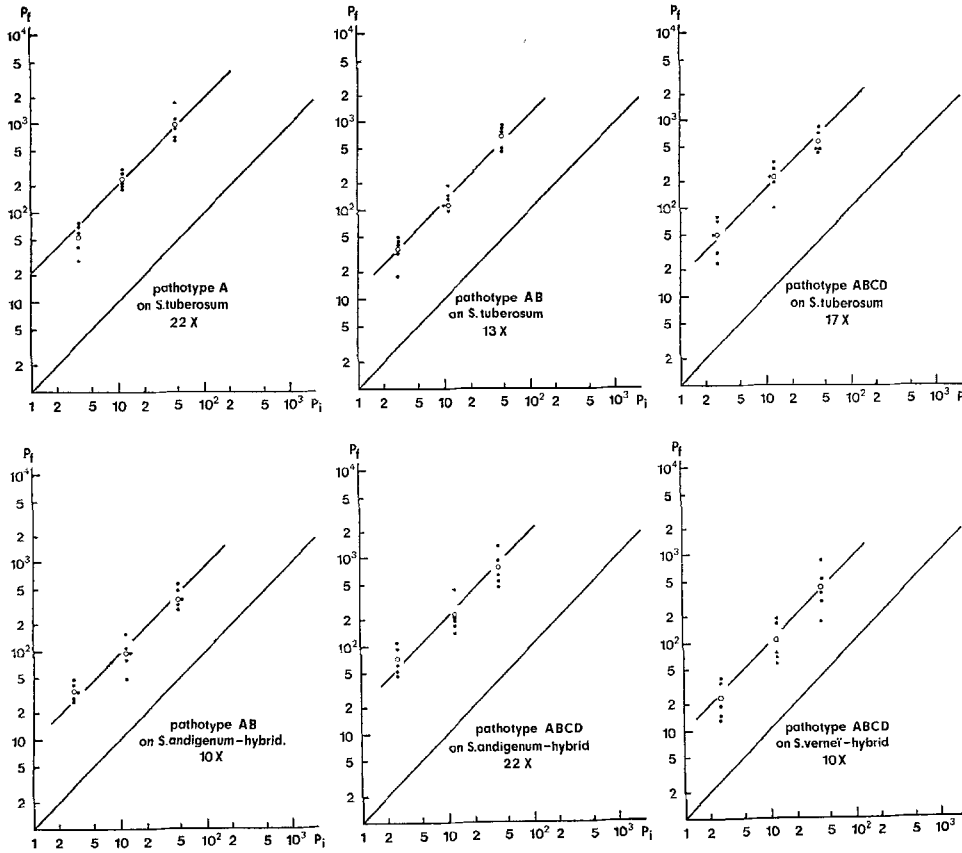

Fig. 1. De vermenigvuldiging van drie pathotypen van Heterodera rostochiensis op drie aardappelvarieteiten in 1966. P_i en P_f zijn begin- en einddichtheden (eieren per 10 g grond).

soil in the 1966 experiment, 0.5, 1.5 and 4.5 eggs per g of soil in the 1967 experiment and 0.5, 1.0 and 2.0 eggs per g of soil in the 1972 experiment. After inoculation and gentle mixing, the 2 kg lots were transferred to the two-litre pots. There were five replications of each nematode density and per potato variety. In March or early April each pot was planted with a suberized plug with a small potato sprout cut from a tuber. Water was then added to bring the moisture content to 15% of the total weight. Pots were randomised on two benches in the same glasshouse, weighed once or twice a week and water added to replace water lost allowing for the estimated weight of the plant as it grew. At each watering the positions of the pots were changed so that all pots occupied five possible positions between back and front of the bench several times during the experiment, and for equal total lengths of time. At the same time they were displaced along the bench and interchanged between half benches three times during the experiments. In 1966 and 1967 'Libertas' (susceptible to all pathotypes), 'Karna 59–387' (resistant to pathotype A) and 'Karna 60–1085' (resistant to

Fig. 2. The multiplication of three pathotypes of *Heterodera rostochiensis* on three potato varieties in 1967. P_i and P_f are inital and final density (eggs per 10 g of soil).

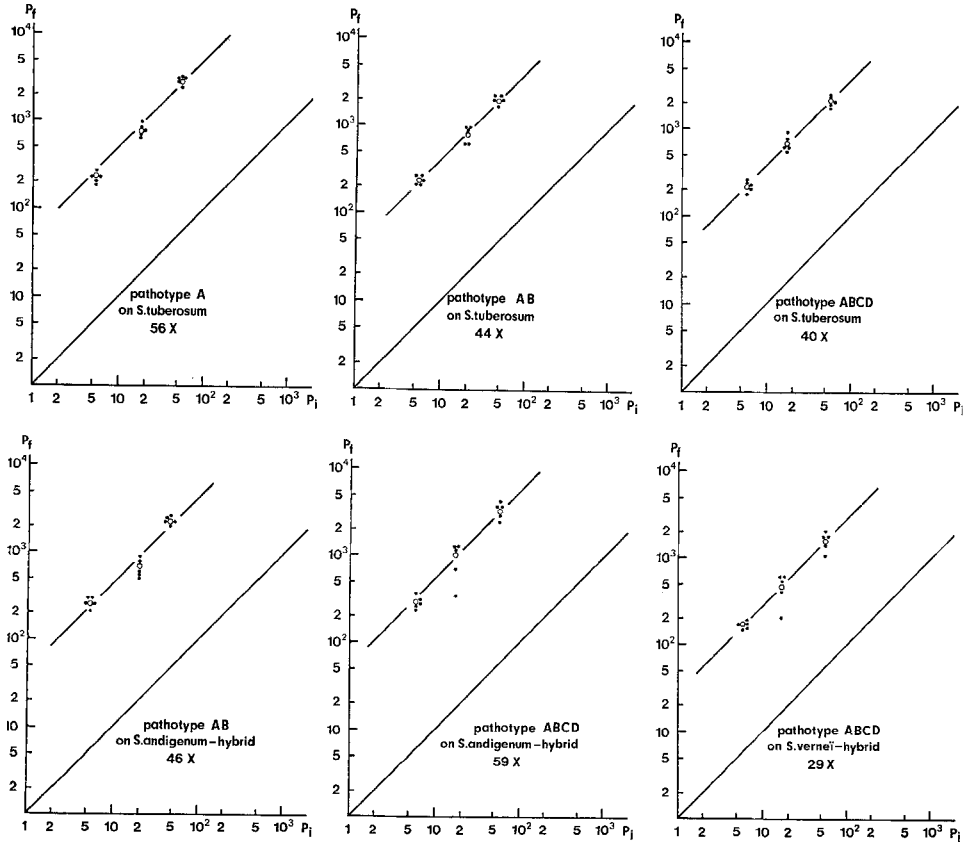

Fig. 2. De vermeningvuldiging van drie pathotypen van Heterodera rostochiensis op drie aardappelvariëteiten in 1967. P_i en P_f zijn begin- en einddichtheden (eieren per 10 g grond).

A and AB) were used in the tests, and in 1972 'Mentor', 'Bintje', 'Sirtema', 'Alpha' and 'Désirée' (susceptible to all pathotypes) 'Proton' and 'Mara' (resistant to A and AB) and 'Saturna', 'Prominent' and 'Prevalent' (resistant to A).

The haulms began to die off 14 to 16 weeks after planting. Final nematode densities in the pots were determined from 375, 750 or 1500 g soil samples at the high, medium and low initial densities respectively.

Results

Final densities are plotted against initial densities for the 1966 and 1967 experiments in Fig. 1 and 2. In 1967 the variation of multiplication rates within the five replications per initial density and per pathotype was much smaller than in 1966. It was independent of log initial density.

Multiplication rates were independent of initial density in all experiments. Averages per potato variety, per nematode pathotype and per experiment are given in Tables 1,

Table 1. The rate of reproduction of the pathotype ABCD on ten potato varieties in 1972. L.s.d. between varieties 6.2 ($\alpha = 0.01$).

Potato variety	Average multiplication
Mentor	43
Bintje	61
Sirtema	51
Alpha	54
Désirée	70
Proton	43
Mara	48
Saturna	53
Prominent	53
Prévalent	75

Tabel 1. De vermenigvuldiging van het pathotype ABCD op tien aardappelrassen in 1972. L.s.d. tussen aardappelrassen: 6,2 ($\alpha = 0,01$).

Table 2. The rate of reproduction of the pathotypes A and ABCD on five potato varieties in 1972. L.s.d. between pathotypes: 3.9 ($\alpha = 0.01$).

Potato variety	Pathotype	
	A	ABCD
Mentor	64	43
Sirtema	69	51
Bintje	55	61
Alpha	50	54
Désirée	59	70

Tabel 2. De vermenigvuldiging van de pathotypen A en ABCD op vijf aardappelrassen in 1972. L.s.d. tussen pathotypen: 3,9 ($\alpha = 0,01$).

Table 3. Comparison of the rate of reproduction of the pathotypes A, AB and ABCD on various potato varieties.

Pathotype		Rates of reproduction of pathotype			Ratio of rates of reproduction of various pathotypes to that of pathotype A			Numbers of eggs per cyst		
		A	AB	ABCD	A	AB	ABCD	A	AB	ABCD
non resistant varieties										
Libertas	1966	22	13	17	1	0.6	0.8	115	82	98
Libertas	1967	56	44	40	1	0.8	0.7	235	170	215
Mentor, Sirtema	1972	67		47	1		0.7	307,274		270,239
Désirée	1972	59		70	1		1.2	278		286
Bintje, Alpha	1972	53		58	1		1.1	311,311		302,263
resistant to pathotype A (ex. S. andigenum)										
Karna, 59–387	1966		10	22		0.5[1]	1[1]		106	71
Karna, 59–387	1967		46	59		0.8[1]	1[1]		229	229
Saturna, Prominent	1972			53			0.8[2], 1[3]			261,276
Prevalent	1972			75			1.1[2], 1.4[3]			308
resistant to pathotype AB (ex. S. verneï)										
Karna 60–1085	1966			10			0.5[1]			70
Karna 60–1085	1967			29			0.5[1]			223
Proton, Mara	1972			46			0.7[2], 0.9[3]			277,294

[1] Multiplication of A on 'Libertas' = 1
[2] Multiplication of A on 'Mentor', 'Sirtema' = 1
[3] Multiplication of A on 'Bintje', 'Alpha' = 1

Tabel 3. Vergelijking van de vermenigvuldiging van de pathotypes A, AB en ABCD op verschillende aardappelrassen.

2 and 3. Table 3 also gives ratios between rates of reproduction of the various pathotypes on each variety tested and those of pathotype A on the same variety or a comparable variety if the first was resistant to pathotype A. Finally numbers of eggs per cyst are shown.

Discussion

According to the 1966 and 1967 results together rates of multiplication of ABCD on 'Libertas' and the *S. verneï* hybrid 'Karna 60–1085' are distinctly to considerably smaller than of A on 'Libertas'. The same holds for ABCD and A on 'Mentor' and 'Sirtema' in 1972. Rates of multiplication of AB on 'Libertas' and on the *S. andigenum* hybrid 'Karna 59–387' were the same and lower than of A on 'Libertas'. The 1972 results (Tables 1 and 2) agree with Kort's (1966) results that there are (significant and sometimes large) differences between the rates of reproduction of the same pathotype on different potato varieties.

However, densities are given by Kort (1966) as cysts per pot. This introduces the possibility of differences of egg content per cyst between pathotypes both in initial and

final populations as a partial cause of the differences in multiplication rates he found. The results given here differ from those of Kort (1966) in that differences in multiplication rate of ABCD and A on varieties susceptible to both pathotypes are much smaller than Kort's (1966) figures suggest. Moreover, contrary to the latter, multiplication rates of ABCD tend to be smaller than of A on the same variety.

Multiplication rates of pathotype ABCD on three varieties resistant to pathotype AB were smaller than the average multiplication rates on the varieties susceptible to pathotype A, investigated here, and therefore certainly smaller than of pathotype A on the latter.

Samenvatting

De vermenigvuldiging van drie pathotypen van het aardappelcystenaaltje op verschillende aardappelrassen

In twee potproeven vermenigvuldigden de pathotypen AB en ABCD van *Heterodera rostochiensis* zich minder sterk op het aardappelras 'Libertas' dan pathotype A. Pathotype ABCD vermenigvuldigde zich even sterk op een tegen pathotype A resistente *S. andigenum*-hybride als pathotype A op 'Libertas'. Pathotype AB vermenigvuldigde zich minder sterk op 'Libertas' en een tegen A resistente variëteit dan A op 'Libertas'.

In een derde proef met de pathotypen A en ABCD en vijf voor alle pathotypen vatbare aardappelrassen, twee tegen A en AB resistente en drie tegen A resistente rassen, werden significante verschillen aangetoond tussen de vermenigvuldiging van dezelfde pathotypen op verschillende daarvoor gevoelige aardappelrassen (Tabel 1 en 2). Tabel 3 geeft de indruk dat pathotype ABCD zich op de getoetste rassen minder sterk vermeerdert dan A op de daarvoor vatbare rassen.

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References

Kort, J., 1966. The occurrence of mixtures of pathotypes in *Heterodera rostochiensis* Woll. Meded. Rijksfac. Landb. wet. Gent 31: 601–608.

Seinhorst, J. W., 1967. The relationships between population increase and population density in plant parasitic nematodes. II. Sedentary Nematodes. Nematologica 13: 157–171.

Address

Instituut voor Plantenziektenkundig Onderzoek (IPO), Binnenhaven 12, Wageningen, the Netherlands.