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PARTIAL INFECTION WITH POTATO VIRUS Y^N OF TUBERS FROM PRIMARILY INFECTED POTATO PLANTS[1]

Gedeeltelijke besmetting met aardappel-Y^N-virus van knollen van primair besmette aardappelplanten

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A field experiment was designed to obtain information on the extent of partial infection of 'Bintje' potato tubers with potato virus Y^N. Data from eight fields, in which plants were artificially infected with the virus, showed that tubers with a weight lower than 30 g became infected only about half as frequently as bigger tubers; the latter were divided into three groups of 30–60 g, 60–90 g and over 90 g, but there were no significant differences in the extent of infection in these groups. In the same experiment it was found that the heel end of a tuber is less frequently infected than the rose end. This means that in testing samples of potato tubers for the presence of potato virus Y^N it is preferable to grow the rose end of the tuber.

INTRODUCTION

Investigations on translocation of viruses in potato plants led to the conclusion that tubers of primarily infected potato plants are very often only partially infected. This means that one or more parts of a tuber may be infected while other parts of the same tuber are not and also that among a set of tubers from one plant both healthy and infected tubers may be found. These phenomena were determined for potato virus X (BEEMSTER, 1958), potato viruses Y^O and Y^N (BEEMSTER, 1961a) and potato leafroll (BEEMSTER, 1961b). It can be stated that a set of totally infected tubers is generally obtained only when the inoculation is performed before tuber formation has started. Inoculation when tubers are already present often does not lead to complete infection of the tubers, even when the period between inoculation and harvest is rather long. There is one exception known: when potato virus Y^N is inoculated rather late in the growing period, the tubers may become completely infected. It must be said, however, that in experiments with this virus partial infection is also common, e.g. when the period between inoculation and harvest is relatively short or when the inoculation is performed in an advanced stage of growth of the potato plant.

The question of partial infection is important with regard to the possibility of detecting viruses in potato tubers, especially in relation to seed potato inspection. From experiments with potato virus X (BEEMSTER, 1958) it could already be concluded that 1. the biggest tubers of single-stemmed plants and the rose end of the tubers become infected most frequently; 2. in partially infected tubers, virus X was not found in higher percentage in tubers stored at room temperature than in tubers stored at 4 °C for six months. As experiments of this nature had not been performed with potato virus Y^N it was decided to investigate the occurrence of partial infection with this virus in the following experiment.

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EXPERIMENT

On 27 June 1963 100 plants (variety 'Bintje') in each of four different potato fields A, B, C and D, in the province of Groningen were inoculated with potato virus Y^N. The inoculation was performed with sap from infected potato plants (variety 'Rekord') grown in a glasshouse. This sap was mixed with Carborundum and then rubbed on the leaves. At least one leaf on each stem of the plants was inoculated. The date of inoculation was chosen rather late – *viz.* towards the date of the expected appearance of aphids in the field – in order that we might obtain some idea of the rate of development of mature plant resistance under field conditions. One week after the first inoculation another 100 plants in the same fields were inoculated in the same way. Three weeks after each of the inoculations the plants were harvested. The tubers from each field and each inoculation date were put into separate bags. Although the experiment was designed to provide some information about mature plant resistance under field conditions, it allowed us to study also some details concerning partial infection of the tubers.

The tubers of each of the eight samples were divided into five different groups according to their weights. The tubers of the groups 1, 2, 3, 4 and 5 had, respectively, weights of less than 30 g, 30–60 g, 60–90 g and 120 g and over. Some samples had such a small number of tubers of more than 120 g that groups 4 and 5 were put together and will be refered to as group 4 in the following. From each sample a number of tubers were taken at random for each of the weight classes. To obtain information on infection of the tubers, these were planted in pots and the plants grown from them tested by using A6 test leaves (DE BOKX, 1964). From each tuber both rose and heel end were planted separately in order to determine which of these parts were infected most frequently under the prevailing conditions.

In Table 1 the complete data obtained after testing of the plants are given. Generally speaking the extent of infection proved to be very suitable for obtaining information on partial infection, the total amount of infection being neither too high nor too low. There were considerable differences in the amount of infection in the different fields. As no complete data of the fields in which the experiment was performed were available, it is difficult to explain these differences. Date of planting, size of the planted seed potatoes and the amount and type of fertilizer might have been factors responsible for the differences. Comparing the percentages of infection at the first and second dates of inoculation and harvesting, it will be noticed that the differences in the amounts of infection are rather curious. Field A showed a markedly smaller amount of infection after the late inoculation than after the early inoculation, as might have been expected; field B, however, showed no difference and fields C and D even showed a higher percentage after the late inoculation.

Mature plant resistance has had no effect here, in that consistent differences between the amounts of infection after the two inoculations cannot be detected. On the other hand it can be stated that in the experiment as a whole all plants had a certain degree of mature plant resistance, since, if this were not so, the infection rate would have reached a much higher level.

The data on partial infection offer a reliable basis for further considerations. The extent of infection in the groups classified according to the weights of the tubers shows that in almost all cases tubers of less than 30 g had a lower percen-

TABLE 1. Infection of rose and heel end of 'Bintje' potato tubers of different weights after primary infection with potato virus Y^N under field conditions.

De besmetting van de top- en basisoogstek van aardappelknollen van verschillend gewicht bij primaire besmetting met aardappel-YN-virus.

Field	Tubers		Infected 27 June; harvested 18 July					Tubers	Infected 4 July; harvested 25 July				
	Weight grams	Number	a[1]	b	c	d	% tuber infection	Number	a	b	c	d	% tuber infection
A	<30	50	5	4	2	39	22	50	1	3	0	46	8
	30–60	49	9	6	0	34	31	50	0	4	0	46	8
	60–90	44	8	9	2	25	43	50	0	4	1	45	10
	>90	18	4	2	2	10	44	47	0	2	0	45	4
B	<30	47	0	4	1	42	11	50	3	0	1	46	8
	30–60	42	1	9	1	31	26	50	10	5	0	35	30
	60–90	50	4	5	4	37	26	50	6	7	0	37	26
	>90	21	1	3	0	17	19	36	2	6	0	28	22
C	<30	50	2	0	1	47	6	50	2	2	1	45	10
	30–60	48	2	1	0	45	6	50	7	4	0	39	22
	60–90	52	3	6	0	43	17	50	7	3	0	40	20
	>90	78	1	6	1	70	10	100	8	9	0	83	17
D	<30	50	1	1	0	48	4	50	8	5	1	36	28
	30–60	50	8	2	2	38	24	50	14	3	4	29	42
	60–90	50	6	2	1	41	18	50	15	7	0	28	44
	>90	100	6	7	1	86	14	100	27	22	3	48	52

1 a: Number of tubers of which both rose and heel end were infected
b: Number of tubers of which rose end infected and heel end not
c: Number of tubers of which rose end not infected and heel end infected
d: Number of tubers of which neither rose nor heel end was infected

tage of infection than those of the other groups. The differences between groups of tubers weighing more than 30 g were relatively small and inconsistent. Statistical analysis indeed confirmed that the degree of infection in tubers of a weight less than 30 g was significantly lower than that of tubers in the other groups. The mean percentages for the groups 1, 2, 3 and 4 were 11.2, 22.4, 24.7 and 21.0 respectively. The result as a whole is probably of little importance for commercial practice, as tubers smaller than 30 g are rarely used as seed potatoes.

Table 1 gives the data obtained on infection of the tubers: (a) infected at both ends, (b) at the rose end only, (c) at the heel end only and (d) the number showing no infection at all. From the results as a whole it is very clear that testing of the rose end only or the heel end only does not give a complete picture of whether a tuber is infected or not. It is even known from earlier experiments that it is possible for both rose and heel end to produce healthy plants, whereas a plant grown from the middle region of the tuber may prove to be infected. In the present experiment no data on this point were obtained. For practical purposes, however, considering the number of tubers to be tested, it is only possible to test one eye-cutting per tuber. From Table 1 it becomes clear that in most cases testing of the rose end will lead to a more accurate result than testing the heel end. In this experiment 32 samples were tested and in 27 of these the rose end was found to be infected more times than the heel end. In only three

cases was the heel end infected more often, while in two cases the result was the same for both ends. There is a tendency for the bigger tubers to give more accurate results with the rose ends than the smaller ones.

DE BOKX (1964) described experiments in which he tried to detect potato virus Y^N in tubers from primarily infected plants; it was found that during a short period after inoculation the rose end showed a higher concentration of virus than the heel end. However, 15 days after inoculation no differences could be detected. In the experiment described here differences between rose end and heel end were found up to three weeks after inoculation. Probably it is not possible to give the exact time after which no differences between both ends can be found. This may depend, for example, on the stage of growth of the plants at the time of inoculation. In the experiments described by DE BOKX the inoculations were performed 9 and 10 weeks after planting under glasshouse conditions, while in our own experiment the inoculation took place at least three months after planting. Under these conditions the virus will probably never reach both parts of the tubers with equal frequency.

SAMENVATTING

Een veldproef, waarbij aardappelplanten kunstmatig met aardappel-Y^N-virus werden geïnoculeerd met het doel nadere gegevens te verkrijgen omtrent de gedeeltelijke besmetting van knollen met dit virus, leverde de volgende resultaten op. Het percentage besmette knollen met een lager gewicht dan 30 g bleek ongeveer de helft te bedragen van dat van knollen in de gewichtsklassen 30–60 g, 60–90 g en de klasse zwaarder dan 90 g. Tussen de drie laatstgenoemde groepen traden geen betrouwbare verschillen in besmetting op.

Verder bleek dat in alle gewichtsklassen de oogstek genomen van de top van de knol meer kans heeft met Y^N-virus besmet te geraken dan de oogstek genomen van het naveleinde van de knol. Voor de nacontrole van aardappelpootgoed betekent dit, dat het toetsen van een oogstek van de top van een knol voor dit doel beter geschikt is dan de oogstek van het naveleinde. De knolgrootte speelt hierbij blijkbaar geen rol van betekenis, daar knollen lichter dan 30 g in het algemeen niet voor pootgoed worden gebruikt.

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