JOURNAL OF PLANT PROTECTION RESEARCH
Vol. 42, No. 2 (2002)

THE SPREAD OF PVY, PVM, PVS AND PLRV AT BONIN CONDITIONS DURING 1996–1999

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Accepted: March 27, 2002

Abstract: The investigations were carried out at Bonin during 1996–1999. The aim of the study was the comparison of PVY, PVS, PVM and PLRV infection pressure in different periods of growing season. The PVY pressure was the greatest. The mean (of 4 years) infection was 32%. Evidently lower infection was observed for PVS (19%) and PVM (7%) and extremely low for PLRV (only 0.01%). The most intense spread of PVY, PVS and PVM took place from second 10 days of July until first ten days of August.

Key words: aphids, potato viruses

INTRODUCTION

The spread of potato virus diseases depends upon many factors, particularly environmental conditions that mostly affect the occurrence of virus vectors.

The aim of the carried out studies was to compare the pressure variability of following potato viruses: *Potato virus Y* (PVY), *Potato virus M* and *Potato virus S* (PVM and PVS) and *Potato leafroll virus* (PLRV). Also the purpose of the study was to examine the similarities or differences of the dynamic of virus spread in regard to different periods of vegetative season. This knowledge is essential for virus disease epidemiology and for certified seed production with references to forecasting the incidence of tuber infection with viruses. Those forecasts are elaborated before tuber harvesting every year and do not only inform about the threat of virus infections but also predict the range of degradation and disqualification of seed potatoes. The importance of the forecasts to farmers is unquestionable in regard to seed production schemes and seed potato distribution.

MATERIAL AND METHODS

The studies were carried out in Bonin (Zachodniopomorskie province) in the years 1996–1999. Monitoring of spring migration of first aphid individuals and a

dynamic of their occurrence was performed on the basis of collected material. Aphids were trapped in two yellow Moericke's dishes filled in 3/4 with water and 2–3 droplets of liquid decreasing surface tension. The traps were placed inside plantation of healthy potato plants cv. Baszta on fallow 20 × 20 m. The observations were conducted beginning in May until August. The material from dishes was collected every day (excluding Saturdays and Sundays) in early morning hours. Each dish was handled as one individual treatment. First, the collected insects were treated with 70% alcohol and afterwards in laboratory conditions the species were identified using a stereoscopy microscope. Data was transformed according to a formula lg (n+1), where n denotes a number of aphids.

To estimate the course of infection pressure for each individual virus the tested plants (healthy plants of cv. Lotos grown from tubers obtained in tissue cultures) were replaced at 10-day intervals beginning May 20 (beginning of aphid migration) until the end of August. Each time 20 healthy plants were placed in close proximity to sources of respective viruses (plants grown from infected tubers) for 10-day period. The following cultivars were the sources of the viruses: Jagoda (infected with PVY), Omulew infected with PVM), Ina (infected with PLRV), and breed line ZAZ 5293 (infected with PVS). Then the tested plants were taken to a greenhouse. After a cease of vegetation the tubers were harvested and put into storage. In the next year they were planted in a following experiment in a tuber indexing proof in a greenhouse. The outgrown plants were taken for the diagnostic analysis using ELISA test.

RESULTS AND DISCUSSION

The mean tuber infection in % (analysis of 4 years) with PVY, PVM, PVS and PLRV is presented in figure 1. PVY showed the highest pressure as 32% of tubers were infected. The distinctive lower infection incidence was counted for PVS (19%) and the lowest for PVM (7%). The extremely low infection with PLRV virus (only just 0.01%), the value impossible to disclose on the figure) might mean that in Bonin conditions the seed production of cultivars more resistant to this virus (the resistance of the Lotos, cultivar included in the experiment is estimated as 7 in 9-degree scale where 1 means the highest susceptibility and 9 the best resistance) can be conducted without taking the risk of degradation and disqualification of certified seed potatoes. It was the main reason that the virus PLRV was excluded from the latter analysis. Similar ratio of other virus infections was observed in all years of conducted studies (Fig. 2). The small differences were recorded in 1999. Then PVS infection was slightly higher (19.7%) as compared with PVY infection (15.6%).

The infection incidence of PVY virus was the highest in 1997 and 1998 (47% and 43%, respectively) what considerably differed from results obtained in 1996 and 1999 (15.5% and 15.6%, respectively). The differences in PVS infection between each individual year were much smaller and ranged from 8% in 1996 to 23% in 1997. Whereas, PVM infection did not change too much over the period of conducted studies and ranged from 3.3% in 1996 to 6.9% in 1998.

While comparing the mean infection of 4 years (Fig. 3) it might be stated that the PVY virus spread was the most intense beginning in second ten days of July un-

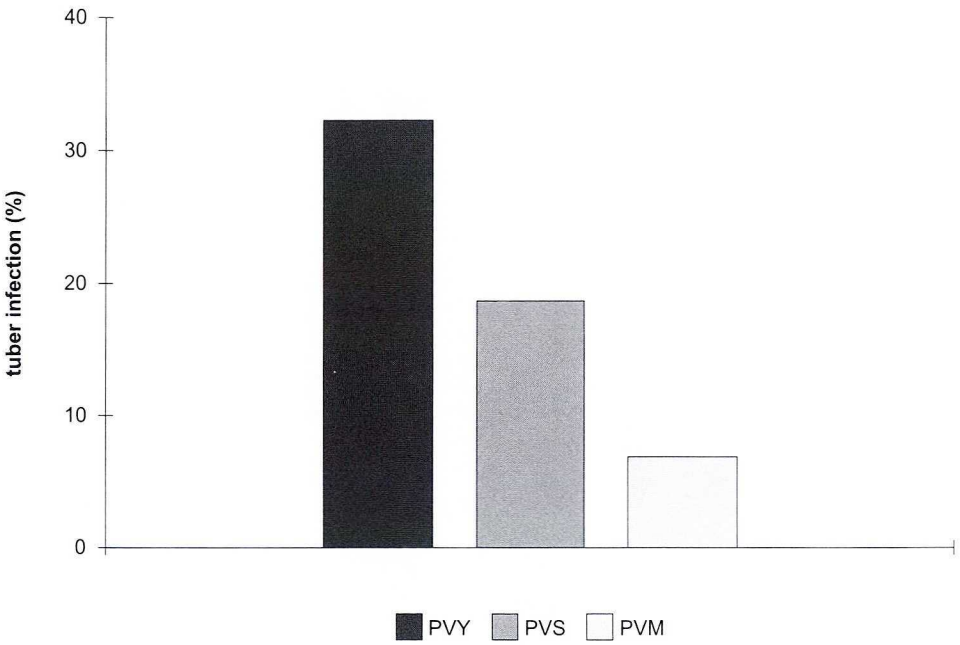

Fig. 1. The spread of PVY, PVS and PVM at Bonin (mean of 1996–1999)

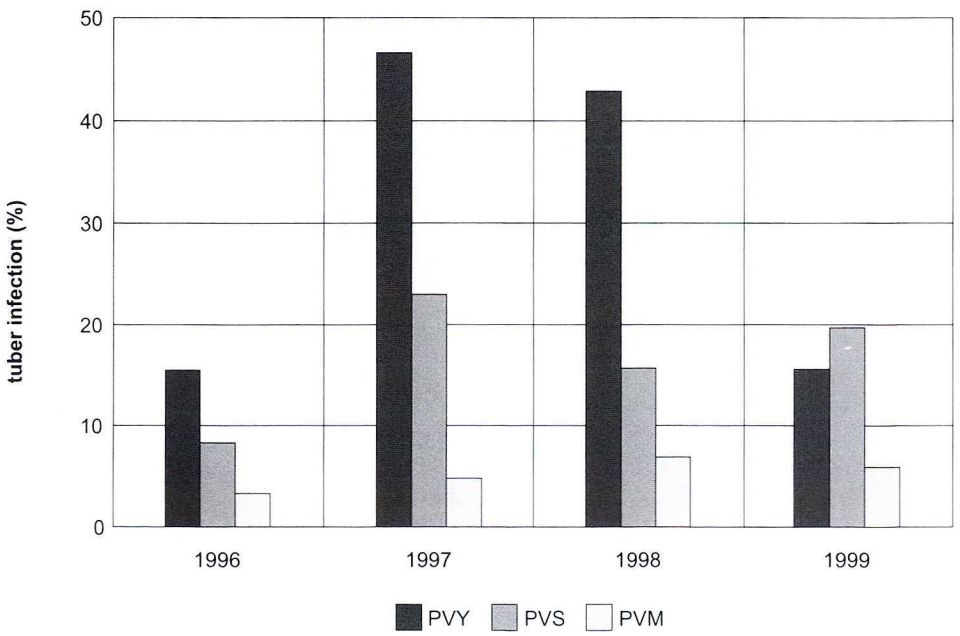

Fig. 2. The spread of PVY, PVS and PVM at Bonin during 1996–1999

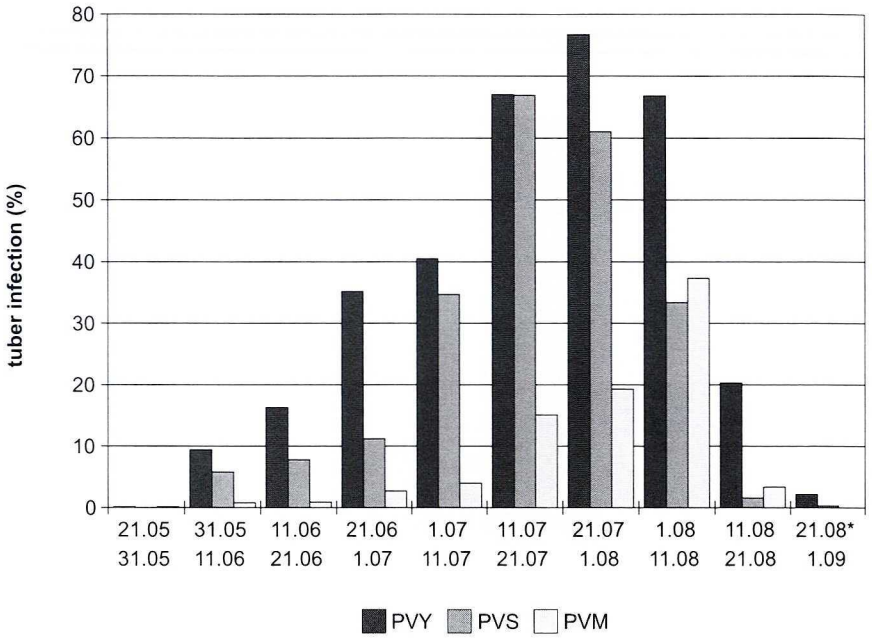

Fig. 3. The dynamics of PVY, PVS and PVM spread in different periods of growing season at Bonin (mean of 1996–1999)

* – the numerator indicates the time of placing the test plants in the neighbourhood of viruses sources and denominator the time of removal.

This remark refers also to the figures: 4, 5, 6 and 7

til first ten days of August, while PVS in second and third ten days of July. All the same, the highest mean PVM infection was recorded a little later, in second ten days of August. It resulted from the high rate infection in the years 1996–1997 (Figs 4, 5) that significantly differed from data obtained in 1998 and 1999 (Figs 6, 7). It is hard to explain such dissimilarity. One might assume that the presence of aphids not colonizing the potato plants has affected PVM virus infection but there is no evidence for that in literature.

Analyzing the results presented in figures 4–7 they can be noted the similarities in the pressure dynamics of PVY, PVS and PVM throughout the vegetative season. The data can suggest that factors having the significant impact of the virus spread are similar, however at this moment it is impossible to evaluate them. It is well known that besides climatic conditions, aphids are the main keys in transmitting viruses (Gabriel 1989). Nevertheless, aphid species have different capabilities to carry viruses. There are some called "potato aphids" well recognized as the main aphids transmitting viruses but there are also others that can not colonize potato plants but own the ability to infest potatoes and transmit nonpersistent viruses (Kostiw 1980; van Hoof 1980).

On the basis on the results from the years 1997–1998 there is being observed the impact of "non-potato aphids" on PVY, PVS and PVM transmission. The main evidence is the rate of tuber infection with PVY, PVM in third ten days of May in 1998,

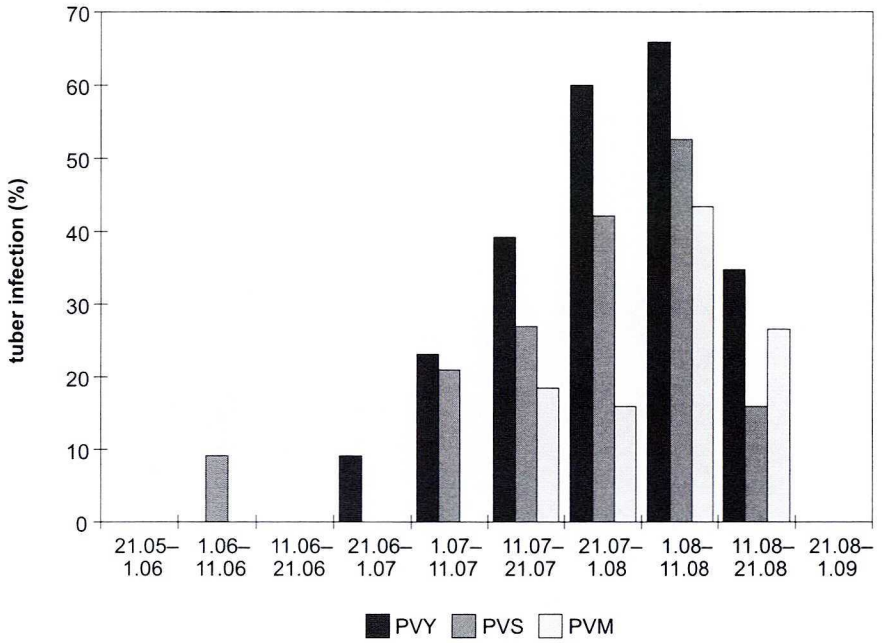

Fig. 4. The dynamic of PVY, PVS and PVM spread in different periods of growing season at Bonin in 1996

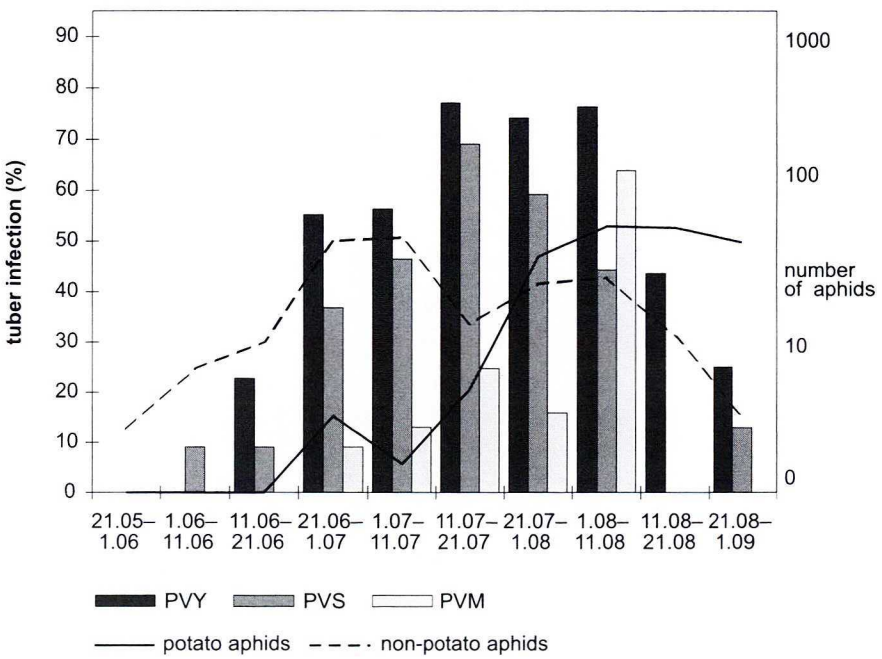

Fig. 5. The dynamics of PVY, PVS and PVM spread and winged aphids incidence in different periods of growing season at Bonin in 1997

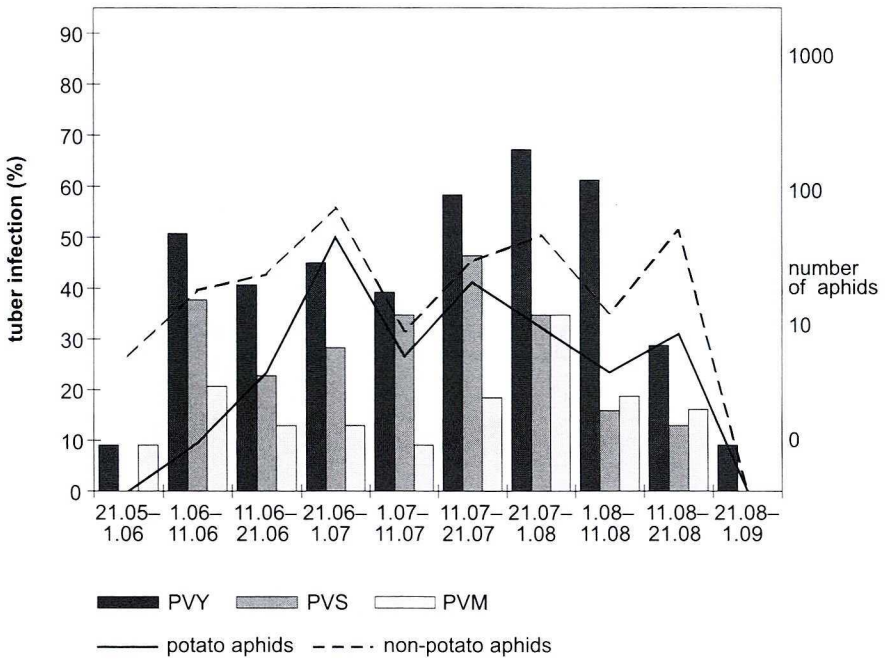

Fig. 6. The dynamics of PVY, PVS, PVM spread and winged aphids incidence in different periods of growing season at Bonin in 1998

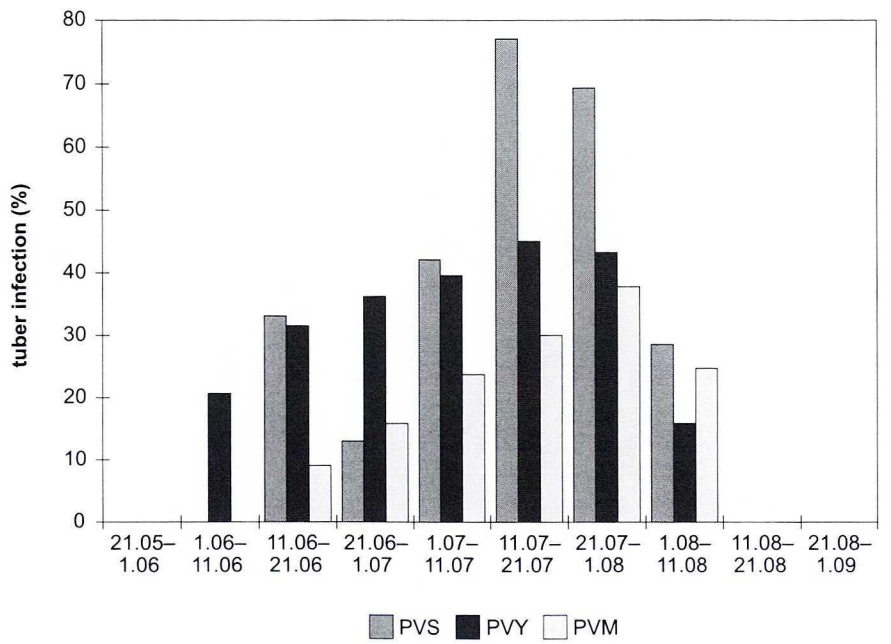

Fig. 7. The dynamic of PVY, PVS, PVM spread in different periods of growing season at Bonin in 1999

PVY, and PVS in first and second ten days period of June in 1997. At that time there was no potato aphids noted in plantations. On the contrary there were other aphid species recorded and they have been considered as virus vectors.

The latter undertaken study will focus on those non-potato aphids to estimate their role in virus transmissions.

CONCLUSIONS

1. PVY presents the highest threat to potato production in Poland. PVS and particularly PVM spread much less and PLRV virus seems to be insignificant at all.
2. The data from the years 1996–1999 indicates that all three viruses (PVY, PVS and PVM) being transmitted by aphids in the non-persistent mode spread the most intense from second ten days of July until first ten days of August. In some years the intense spread was observed throughout the whole vegetative season.
3. The conducted studies confirmed the previous results concerning the non-potato aphids as PVY, PVS and PVM vectors.
4. On the basis on the similarities in the pressure dynamics of PVY, PVS and PVM throughout the vegetative season one can assume that similar factors have an impact on virus epidemiology. It would become possible to reach the enhanced conclusion after better knowledge of non-potato aphids' role in transmitting PVY, PVM and PVS viruses and also the influence of substrate moisture on tuber infection with PVM and PVS.

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POLISH SUMMARY

SZERZENIE SIĘ PVY, PVM, PVS I PLRV W LATACH 1996–1999 W WARUNKACH BONINA

Badania przeprowadzono w Boninie (woj. zachodniopomorskie) w latach 1996–1999. Ich celem było porównanie presji PVY, PVM, PVS i PLRV oraz poznanie czy dynamika szerzenia się tych wirusów w różnych okresach sezonu wegetacyjnego jest podobna, czy zróżnicowana. Największa była presja PVY (32% porażonych bulw), następnie PVS (19%) i PVM (7%). Wyjątkowo niskie porażenie bulw przez PLRV (0,01%) może oznaczać, że w warunkach Bonina produkcja nasienna ziemniaków odmian odporniejszych (użyta w doświadczeniu odmiana Lotos charakteryzuje się odpornością „7" w skali 9-stopniowej, przy czym „1" oznacza najwyższą podatność, a „9" – skrajną odporność), może być prowadzona bez większego ryzyka degradacji lub dyskwalifikacji materiałów nasiennych.

Najintensywniej PVY, PVS i PVM szerzyły się w okresie od drugiej dekady lipca do pierwszej dekady sierpnia.

Na podstawie zbliżonego na ogół przebiegu dynamiki presji PVY, PVS i PVM w różnych okresach sezonu wegetacyjnego można przypuszczać, że na epidemiologię tych wirusów mają wpływ zasadniczo zbliżone czynniki.