ABSTRACT OF HABILITATION THESIS

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SEED-TRANSMITTED CEREAL VIRUSES – OCCURRENCE IN POLAND AND POTENTIAL HARMFULNESS

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Key words: cereal viruses, seed-transmission, *Barley stripe mosaic virus, Soil-borne cereal mosaic virus, Tobacco mosaic virus*

There are only few cereal viruses known as seed-transmitted. *Barley stripe mosaic virus* (BSMV), transmitted mainly by seeds and mechanically, is considered the most important and dangerous in this group. It was found and identified for the first time in Poland in 2001 by the author. Previously, some results of investigations on *Soil-borne cereal mosaic virus* (SBCMV) suggested that the virus might be also seed-transmitted. Therefore, studies were undertaken aiming at the elucidation of the problem of seed-transmitted cereal viruses occurring in Poland. Three virus species were the objects of the research: BSMV, SBCMV and *Tobacco mosaic virus* (TMV).

The objective of the studies on BSMV was evaluation of the virus incidence in barley seeds and risk of yield losses in barley crops. The BSMV occurrence was investigated in barley seeds and in field plants using ELISA test. The worked out procedure of BSMV diagnostics in seeds consisted of indirect virus detection in young seedlings grown from tested seeds. The virus was detected in barley seeds as well as in leaves collected from the field. However only mild strains of BSMV were found. In the years 2000–2003, 31 barley cultivars were assayed for BSMV presence (24 of spring barley and seven of winter barley). Seeds of 12 cultivars were proved to be BSMV infected. The highest percentage of BSMV-infected seeds was found in the winter barley cv. 'Kos'. Besides, the following cultivars contained BSMV-infected seeds: 'Annabell', 'Antek', 'Barke', 'Blask', 'Boss', 'Scarlett' and 'Stratus' (spring cultivars) as well as 'Gregor', 'Kroton', 'Tiffany' and 'Tramp' (winter cultivars). BSMV was not detected in three commercial barley cultivars: 'Lot', 'Nagrad' and 'Rodion'.

The occurrence of BSMV was also evaluated in breeding materials. In the years 2003–2004, 105 breeding lines of barley were tested. BSMV presence was revealed in 37 lines. Pedigree analysis of BSMV bearing lines indicated the possible sources of the virus introduction into new cultivars. The most frequent parent form in the pedigrees of BSMV-infected new lines was the old spring barley cultivar 'Atol'. Another probable sources of BSMV were spring barley cv. 'Krona' (Swedish) and winter barley cv. 'Tiffany' (German).

BSMV seed-transmission rate was investigated in the case of seven barley cultivars: 'Annabell', 'Antek', 'Blask', 'Kroton', 'Scarlett', 'Stratus' and 'Tiffany'. The highest seed-transmission rate, 11.7%, was noted for cv. 'Kroton'. For other cultivars seed-transmission rates were as follows: 'Stratus' – 9.9%, 'Annabell' – 6.9%, 'Scarlett' – 6.6%, 'Antek' – 4.9%, 'Tiffany' – 3.8% and 'Blask' – 0.6%.

Incidence of BSMV in barley plants from fields was evaluated in the years 2002–2003. Only plants with mild disease symptoms were collected for diagnostic analyses. In total, 687 samples were tested. In 2002, 146 winter barley plants were assayed. BSMV was detected in 37 samples (in cultivars: 'Bombay', 'Camilla', 'Carola', 'Gil', 'Horus', 'Lomerit', 'Tiffany' and 'Tramp'). In 2003, three spring barley cultivars ('Blask', 'Scarlett' and 'Stratus') were screened for BSMV incidence, in three locations. In every cultivar and in each location the virus presence was confirmed. However, the rate of infection varied considerably. In total, 92 barley plants were found infected out of 540 tested (18.5%).

The results presented above point out that BSMV is rather frequent in Poland. However, in field crops it remains unnoticeable because of the lack of typical, characteristic disease symptoms.

The influence of BSMV infection on the yield and weight of 1000 kernels was evaluated in a field experiment performed in the years 2004–2005. Two spring barley cultivars were chosen, 'Annabell' and 'Blask'. In 2004, differences between healthy and BSMV-infected plots with respect to the yield and weight of 1000 kernels were evident. In the case of cv. 'Annabell' the yield loss was 17.1% and 1000 kernels weight was lower about 9.2% comparing to the healthy control. These differences were confirmed statistically. In the next year the results did not show the same tendency. Statistical analysis was performed for the set of the empirical data obtained during the two-year experiment. It showed that in spite of the negative effect of BSMV infection on barley yield and weight of 1000 kernels, the differences were not statistically significant.

The aim of the investigations concerning SBCMV was demonstration that the virus can be seed-transmitted in rye and triticale. Assays for the virus presence in seeds collected from SBCMV infected plants covered rye cultivars ('Amilo', 'Arant', 'Bosmo', 'Dańkowskie Nowe', 'Dańkowskie Złote', 'Esprit', 'Kier', 'Rostockie', 'Walet', 'Warko') and triticale cultivars ('Fidelio', 'Kitaro', 'Lamberto', 'Magnat', 'Mundo', 'Sorento', 'Woltario'). Detection of SBCMV was performed with ELISA, electron microscopy and reverse transcription-polymerase chain reaction (RT-PCR). Seeds were assayed indirectly, as in the case of BSMV. Seedlings to be tested for SBCMV presence were grown in conditions preventing hazardous infections with the virus.

The capacity of SBCMV seed transmission was proved in the case of winter rye cv. 'Arant'. Seed-transmission rate was rather low and probably this way of transmission does not play any important role in the epidemiology of soil-borne mosaic. However, it may be the way of long distance spreading of the virus.

In course of the studies of SBCMV in rye seeds the presence of virus-like particles of unknown identity was revealed in seeds of rye, triticale and wheat. Morphologically, the particles, tentatively named "seed-borne cryptic virus", resembled

long, flexible virions with internal canal. However, other properties did not confirm virological nature of the particles. The structure, origin and biological role of the virus-like particles remain to be elucidated.

The third object of the studies was *Tobacco mosaic virus* (TMV). TMV was detected in barley plants using mechanical inoculation of test plants (*Nicotiana benthamiana* and *N. tabacum* var. 'Xanthi') and RT-PCR. In barley seedlings grown from seeds originating from TMV-infected mother plants the presence of TMV RNA was demonstrated. Surprisingly, disease symptom expression was not observed. Percentage of TMV-infected barley seedlings grown from seeds stored for 10 months was lower than that revealed in the case of five-months' seed storage.

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The habilitation colloquium took place with the Scientific Council of the Institute of Plant Protection in Poznań, on December 14, 2006. The degree of *doctor habilitatus* was confirmed on the same date.

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