JOURNAL OF PLANT PROTECTION RESEARCH
Vol. 41, No. 2 2001

IDENTIFICATION OF *BARLEY STRIPE MOSAIC VIRUS* IN POLAND

MAŁGORZATA JEŻEWSKA

INSTITUTE OF PLANT PROTECTION, MICZURINA 20, 60-318 POZNAŃ, POLAND
e-mail: m.jezewska@ior.poznan.pl

Abstract. Investigations on the occurrence of *Barley stripe mosaic virus* (BSMV, *Hordeivirus)* in Poland were performed by testing seeds of 22 barley cultivars. BSMV was detected in seeds of winter barley cv. Tiffany and of spring barley cvs. Scarlett and Stratus. The virus presence was revealed by ELISA test and then confirmed by electron microscopy. Preliminary data on the rate of seed transmission of BSMV in cvs. Scarlett and Stratus are presented.

Key words: barley, *Barley stripe mosaic virus,* seed transmission

I. INTRODUCTION

Barley stripe mosaic virus (BSMV), the type member of the genus *Hordeivirus* (previously hordeivirus group) is known as a serious barley pathogen since its identification in the early 1950s (McKinney 1953). BSMV is seed-borne, rod-shape virus containing tripartite ssRNA genome. The components of BSMV genome are separately encapsidated. Some strains contain also subgenomic RNA. BSMV is characterized by a large diversity of strains differing in such properties as host range, pathogenicity, symptomatology, seed transmissibility and ability to overcome specific host resistance genes (Jackson and Lane 1981; Atabekov and Dolja 1986). Particle lengths of BSMV virions range from 110 to 150 nm (Harrison et al. 1965). BSMV is world – widely distributed. Barley (*Hordeum vulgare* L.) is the principal natural host but some strains incite disease in other cereals such as wheat (*Triticum aestivum* L.) and oat (*Avena sativa* L.). Some species of *Chenopodiaceae* and *Solanaceae* can be experimentally infected. Symptoms produced by different strains in barley, wheat and oat vary in severity and may be latent, mild, moderate, severe, yellow leaf, white leaf, dwarf and necrotic. The most common is systemic stripe mosaics of different types (Atabekov and Novikov 1971; Carroll 1986). The main way of BSMV transmission remains seed-transmission but the virus may be also transmitted by mechanical inoculation. However, some strains become difficult or impossible to transfer by sap inoculation. There are no data on vectors of BSMV (Atabekov and Novikov 1971).

The impact of BSMV infection on the barley yield may be very serious. Chiko and Baker (1978) described a method by which losses in seed yield due to BSMV in commercially grown two-row barley in the Canadian prairies were estimated. Estimates were based on previously obtained survey data on the incidence of BSMV and experimentally determined yield losses for three cultivars. The authors introduced a correction factor in order to cover also symptomless infections. Using this method it was estimated that BSMV in Manitoba and Alberta accounted for yield losses of approximately 7,600 t in both 1974 and 1975.

BSMV is included in the list of quarantine objects and undergo strict control procedures (OEPP/EPPO 1991).

There were no information on the occurrence of BSMV in Poland until 1999. The aim of our work was to answer the question if this quarantine virus is present in our country.

II. MATERIALS AND METHODS

Following barley cultivars were submitted for screening tests:
- spring barley: Barke, Boss, Beryl, Edgar, Lot, Nagrad, Orlik, Orthega, Rabel, Rasbet, Rataj, Rodion, Rudzik, Scarlett, Stratus
- winter barley: George, Gil, Horus, Kos, Kroton, Tiffany, Tramp.

Seeds of cvs. Lot, Nagrad and Rodion were bought in the market as commercial sowing material whereas others were supplied by a plant breeding station.

100 seeds of each cultivar were sown and about 3 weeks after germination 30 plants were selected. Selection was based on the general look of a plant taking into account possible virus – like symptoms. Samples were tested by ELISA method (Clark and Adams 1977). The experiment was repeated twice. Specific immunoglobulin and conjugate anti – BSMV were bought in Agdia, USA. ELISA plates were read spectrophotometrically at 405 nm in Labsystems Uniskan II plate reader. The reactions giving absorbances equal to or greater than twice the average for healthy control samples in the same plate were regarded as positive.

Leaf dip preparations stained with 2% phosphotungstic acid (PTA), 2% uranyl acetate (UA) or 1% ammonium molybdate were examined in a Philips EM 201 electron microscope.

III. RESULTS

Symptoms observed in barley plants to be tested for BSMV were not characteristic. There were no typical mosaic nor stripes on leaves. The only virus – like symptoms which could be noticed on some plants were slight dwarfing and generally weaker development. BSMV was found in plants of 3 barley cultivars: Scarlett and Stratus (spring type) and Tiffany (winter type) among 22 tested. Results of ELISA assays are presented in the Table. We did not register any correlation between symptoms and the incidence of BSMV, plants looking as suspected to be virus – infected were shown to be virus – free and the opposite. The highest rate of BSMV seed transmission was demonstrated in the case of cv. Stratus (8.3% average), in cv. Scarlett this index was slightly lower (6.1%) and in cv. Tiffany definitely lower, only 2.8%. Generally, the virus concentration revealed in ELISA test was poor. The OD value ranged 0.2 – 0.5 with background OD 0,05 – 0.07.

Table

Detection of BSMV in barley seedlings cvs. Scarlett, Stratus and Tiffany by ELISA (number of plants infected / number of plants tested)

Exp. N°	Scarlett	Stratus	Tiffany
1	7/10	13/100	3/100
2	3/30	2/30	2/30
3	1/50	0/50	0/50
Total	11/180 (6.1%)	15/180 (8.3%)	5/180 (2.8%)

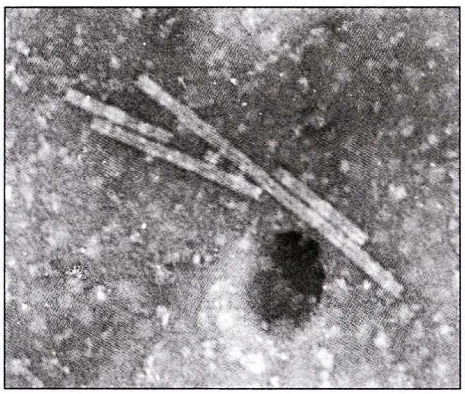

Fig. 1. An electron micrograph of BSMV virions negatively stained with 1% ammonium molybdate (leaf – dip preparation). Magnification of the photograph 152.000×

Fig. 2. Barley plants cv. Stratus infected with BSMV

In electron microscope only single, rod – shaped virions of different lengths were seen (Fig. 1).

Plants found infected with BSMV were observed during their further growth but no characteristic symptoms could be noticed. The feature in common of these plants was generally worse condition in comparison with healthy ones. Fig. 2 presents barley plants cv. Stratus infected with BSMV.

During plant growth the concentration of BSMV decreased and just before heading the virus was already undetectable by means of ELISA test and electron microscopy. Infected plants produced limited amounts of seeds.

Attempts to transmit the virus by mechanical inoculation failed. 24 days after inoculation of 60 plants cvs. Scarlett, Stratus and Tiffany (20 plants of each cultivar) BSMV was detected by ELISA only in one plant (cv. Scarlett).

First testing of freshly obtained kernels from plants infected with BSMV (cvs. Scarlett and Stratus) revealed high seed – transmission ratio of this pathogen. In the case of cv. Scarlett it was 60% (18 plants found infected out of 30 tested) and for cv. Stratus – 43% (13 plants infected out of 30 tested).

IV. DISCUSSION

The lack of typical symptoms in BSMV – infected plants is not very common but it was already reported (Atabekov and Novikov 1971; Chiko and Baker 1978). It makes the diagnostics difficult and requires analytical procedures for the virus detection. Low concen-

tration of virions in the sap of diseased plants renders electron microscopic methods unreliable. In addition, the virus concentration decreases during plant growth and testings risk to be misleading if samples were assayed too late. The failure of mechanical transmission of BSMV could be the result of poor inoculum concentration. However it unequivocally indicates that in the case of our BSMV strain this way of transmission is at least much less effective than seed – transmission.

Our results should be considered as preliminary ones. However the fact BSMV detection should be the impulse for further screening in order to evaluate the distribution of this pathogen in Poland.

Acknowledgements

The author is deeply indebted to ing. Maria Lubik for excellent technical assisstance and to Mrs Danuta Trojanek for taking electron micrographs.

V. REFERENCES

1. Atabekov J. G, Dolja V.V. 1986. Hordeiviruses. Structure and replication. p. 373-395. In "The Plant Viruses. The rod – shaped plant viruses". (M.H.V. Regenmortel and H. Fraenkel – Conrat, eds.). Vol. 2, Plenum, New York.
2. Atabekov J. G., Novikov V.K. 1971. Barley stripe mosaic virus. CMI/AAB Descriptions of Plant Viruses No. 68.
3. Carroll T.W. 1986. Hordeiviruses: Biology and pathology. pp. 373-395. In "The Plant Viruses: The Rod – Shaped Plant Viruses" (M.H.V. Regenmortel and H. Fraenkel-Conrat, H. eds.), Plenum, New York.
4. Chiko A. W., Baker R. J. 1978. Economic significance of barley stripe mosaic virus in Canadian prairies Can. J. Plant Sci., 58: 331-340.
5. Harrison B. D., Nixon H.L., Woods R. D. 1965. Lengths and structure of particles of barley stripe mosaic virus . Virology 26: 284-289.
6. Clark M. F., Adams A.N. 1977. Characteristics of the microplate method of enzyme linked immuno sorbent assay for the detection of plant viruses. J. gen. Virol., 34: 475-483.
7. Jackson A.O., Lane L.C. 1981. Hordeiviruses. p. 565-625. In "Handbook of Plant Virus Infections and Comparative Diagnosis" (E. Kurstak, ed..) Elsevier, Amsterdam.
8. Mc Kinney H.H. 1953. New evidence on virus diseases in barley. Pl. Dis. Reptr., 37: 292-295.
9. OEPP/EPPO. 1991. Barley stripe mosaic hordeivirus. Inspection and test methods for barley seeds. Quarantine procedure N° 34. Bulletion OEPP/EPPO Bulletin 21: 257-259.

Małgorzata Jeżewska

IDENTYFIKACJA WIRUSA PASIASTEJ MOZAIKI JĘCZMIENIA (*BARLEY STRIPE MOSAIC VIRUS*) W POLSCE

STRESZCZENIE

W 2000 roku przebadano 22 odmiany jęczmienia celem sprawdzenia czy w Polsce występuje wirus pasiastej mozaiki jęczmienia (*Barley stripe mosaic virus*, BSMV), znajdujący się na liście obiektów kwarantannowych.

Obecność wirusa wykryto w roślinach następujących odmian: Scarlett i Stratus (jęczmień jary) oraz Tiffany (jęczmień ozimy). Próby testowano metodą ELISA. Przedstawiono wstępne dane dotyczące skuteczności przenoszenia BSMV przez nasiona jęczmienia odmian Scarlett i Stratus.