BIOLOGIA PLANTARUM (PRAHA)

14 (4) : 302 – 304, 1972

BRIEF COMMUNICATION

Virus Origin of the Oat Sterile Dwarf Disease

J. BRČÁK*, O. KRÁLÍK*, and J. VACKE**

*Institute of Experimental Botany, Czechoslovak Academy of Sciences, Praha, **Plant Protection Institute, Praha-Ruzyně

Received January 20, 1972

Abstract. Virus particles (approximately 73 nm in diam.) usually showing an inner capside (45 nm in diam.) and similar to diplornaviruses, esp. reoviruses, were found in some cells of enations in *Avena sativa* and *Arrhenatherum elatius* leaves infected with the oat sterile dwarf disease (OSDD). (The same virus particles were described by the authors in 1966 in the leafhopper vector.)

Mycoplasma-like microorganisms found in 1969 in the OSDD leafhopper vector were absent in OSDD infected plants. Tetracycline did not affect symptom development in plants and did not alter the infectivity of the vector.

Therefore, OSDD is apparently of virus origin; mycoplasmas-like bodies found formerly in the OSDD vector are probably not involved in OSDD etiology.

The properties of a serious disease in oat and barley causing considerable damages *e.g.* in the area of Českomoravská vrchovina and in the northwest districts of Slovakia pointed to its virus origin. PRŮŠA (1958) and PRŮŠA *et al.* (1959) called its agent the oat sterile dwarf virus and discovered its leafhopper vector *Javesella pellucida* (F.). The host range of the oat sterile dwarf disease (OSDD) involving some cereals and many wild species of *Poaceae* (in which the OSDD infection in some cases may be latent) was investigated by VACKE and PRŮŠA (1962). VACKE (1966) described a poor transovarial transmission of the OSDD agent in *J. pellucida* (F.). A very similar and perhaps identical disease also occurs in Scandinavian countries (LINDSTEN 1959, IKÄHEIMO 1961). In spite of detailed knowledge of OSDD including epidemiology and control measures, the causal agent itself remained hidden. BRČÁK *et al.* (1966) and BRČÁK and KRÁLÍK (1969a) observed in the cytoplasma of gut cells of the viruliferous vector *J. pellucida* (F.) isometric virus-like particles, sometimes arranged in tubular structures; however, *Mycoplasma*-like bodies were found in the same object too (BRČÁK and KRÁLÍK 1969b).

While investigating ultrathin sections of parenchyma cells and vascular

* *Address*: Na Karlovce 1, Praha 6, Czechoslovakia.

elements of infected plants we failed to find any virus- or *Mycoplasma*-like particles. Therefore, we focused our attention on the electron microscopy of small vein enations typical for OSDD infection in the leaves of some plant hosts. In order to appreciate the importance of *Mycoplasma*-like bodies present in vector we investigated the influence of tetracycline on the disease development.

Specimens for electron microscopy were taken from enations in the leaves of *Avena sativa* L. and *Arrhenatherum elatius* (L.) PRESL artificially infected by viruliferous leafhoppers *J. pellucida* (F.). Glutaraldehyde and osmium tetroxide were used for fixation (SABATINI *et al.* 1963) and Vestopal W for embedding. Ultrathin sections were made by means of the ultramicrotome Reichert and additionally stained with lead according to RAYNOLDS (1963). Electron micrographs were taken on electron microscopes Tesla BS 413 and JEM-100 U.

For tetracycline treatments we used a solution of tetracycline hydrochloride (50 and 100 p.p.m.) applied twice a week to the roots of oat plants by watering (250 ml for 10 kg of soil in growing boxes) and by sprinkling the plants simultaneously: The first tetracycline treatment began ten days after the transfer of the viruliferous leafhoppers *J. pellucida* (F.) to oat plants, the second treatment began 25 days after the infection of the plants which were beginning to show symptoms of OSDD. In the third trial viruliferous leafhoppers were transferred individually to oat plants, which were treated as above with tetracycline ten days before and then during the 14-day leafhoppers feeding by watering only; after that the inoculativity of individual leafhoppers was tested three times.

Some cells in enations both of *Avena sativa* L. and of *Arrhenatherum elatius* (L.) Presl were filled at random with spherical particles (Figs. 1,2,3) apparently representing the OSDD agent. Most particles contained a dense core, some of them apparently "empty" (Figs. 4,5); the diameter of the particles varied between 63 and 84 nm (the approximate mean 73 nm). Electron micrographs also indicated the structure of the particles, *i.e.* their outer (73 nm) and inner capside (diam. approximately 45 nm).

Tetracycline treatment had no effect on disease development in all the 175 plants investigated. All 89 viruliferous leafhoppers normally transmitted the OSDD agent to tetracycline treated plants both during and after their two-weeks feeding on tetracycline treated oat plants.

Similar virus-like particles found for the first time in inoculative vectors and now in enations of infected plants apparently represent the causal agent of OSDD. On the other hand, *Mycoplasma*-like bodies were absent in diseased plants; moreover neither the development of symptoms in plants nor the inoculativity of leafhoppers was affected by tetracycline, which suggests that *Mycoplasma*-like microorganisms (present in the vector only) were not involved in OSDD etiology.

The structure, shape and size of particles observed in ultrathin sections show similarities to diplornaviruses, especially to reoviruses, like some other phytarboviruses, *e.g.* maize rough dwarf virus, which was discussed in our previous paper (BRČÁK and KRÁLÍK 1972). Other plant pathogenic diplornaviruses belonging to this group might be *e.g.* wound tumor virus and rice dwarf virus.

Aeknowledgement

The authors are grateful to Mr. Katsuhiko I Be for his assistance in taking micrographs on the electron microscope JEM — 100 U.

Figures at the end of the issue.

References

BRČÁK, J., KRÁLÍK, O.: Virus and virus-like particles in gut cells of *Javesella pellucida* (F.) carrying the oat sterile-dwarf virus. — In: Plant Virology (Proc. 6th Conf. Czechosl. Plant Virologists, Olomouc 1967) : 138—141, 1969a.

BRČÁK, J., KRÁLÍK, O.: Mycoplasma-like microorganism and virus particles in the leafhopper *Javesella pellucida* (F.) transmitting the oat sterile dwarf disease. — Biol. Plant. **11** : 95—96, 1969b.

BRČÁK, J., KRÁLÍK, O.: Cytopathological observations in plant hosts and vector of the oat sterile-dwarf disease. — Proc. 7th Conf. Czechosl. Plant Virologists, High Tatras 1971, in press. (1972).

BRČÁK, J., KRÁLÍK, O., VACKE, J.: Virions of the oat sterile-dwarf virus in the midgut cells of its vector *Javesella pellucida*. — Int. Symp. Plant Pathol. Dec. 27, 1966 — Jan. 1, 1967, New Delhi, Abstr. of Papers : 93—94, 1966.

IKÄHEIMO, K.: A virus disease of oats in Finland similar to oat sterile-dwarf disease. — J. Sci. agr. Soc. Finland **33** : 81—87, 1961.

LINDSTEN, K.: A preliminary report of virus diseases of cereals in Sweden. — Phytopathol. Z. **35** : 420—428, 1959.

PRŮŠA, V.: Die sterile Verzwergung des Hafers in der Tschechoslowakischen Republik. — Phytopathol. Z. **33** : 99—107, 1958.

PRŮŠA, V., JERMOLJEV, E., VACKE, J.: Oat sterile-dwarf virus disease. — Biol. Plant. **1** : 223—234, 1959,

RAYNOLDS, E. S.: Use of lead citrate at high pH as an electron-opaque stain in electron-microscopy. — J. cell. Biol. **17** : 209, 1963.

SABATINI, D. D., BENSCH, K., BARRNETT, R. J.: Cytochemistry and electron microscopy. The preservation of cellular ultrastructure and enzymatic activity by aldehyde fixation. — J. cell. Biol. **17** : 19—58, 1963.

VACKE, J.: Study of transovarial passage of the oat sterile-dwarf virus. — Biol. Plant. **8** : 127—130, 1966.

VACKE, J., PRŮŠA, V.: Studium okruhu hostitelů viru sterilní zakrslosti ovsa. (Host range of the oat sterile dwarf virus.) — Rostlinná Výroba (Praha) **8** : 463—474, 1962.

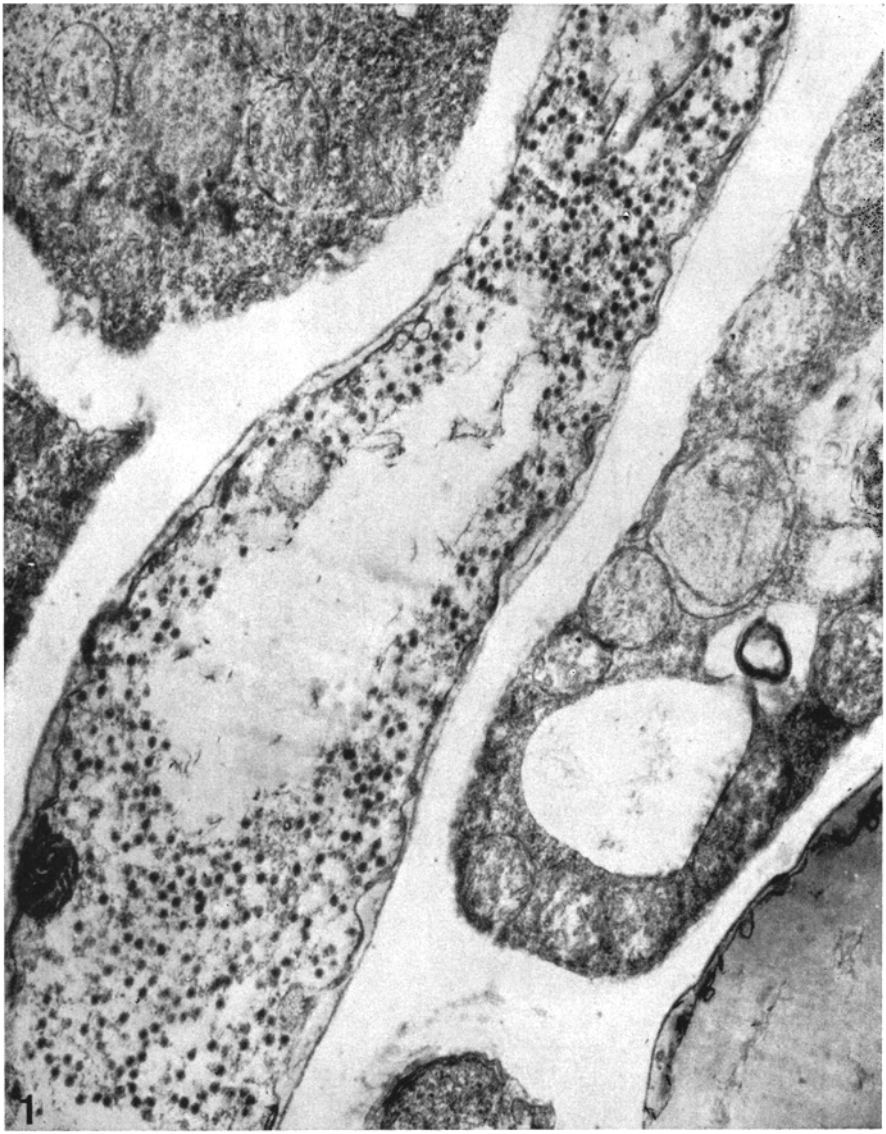


Fig. 1. Electron micrograph of virus particles in a cell of an enation in *Avena sativa* infected with oat sterile-dwarf disease (20 000×)

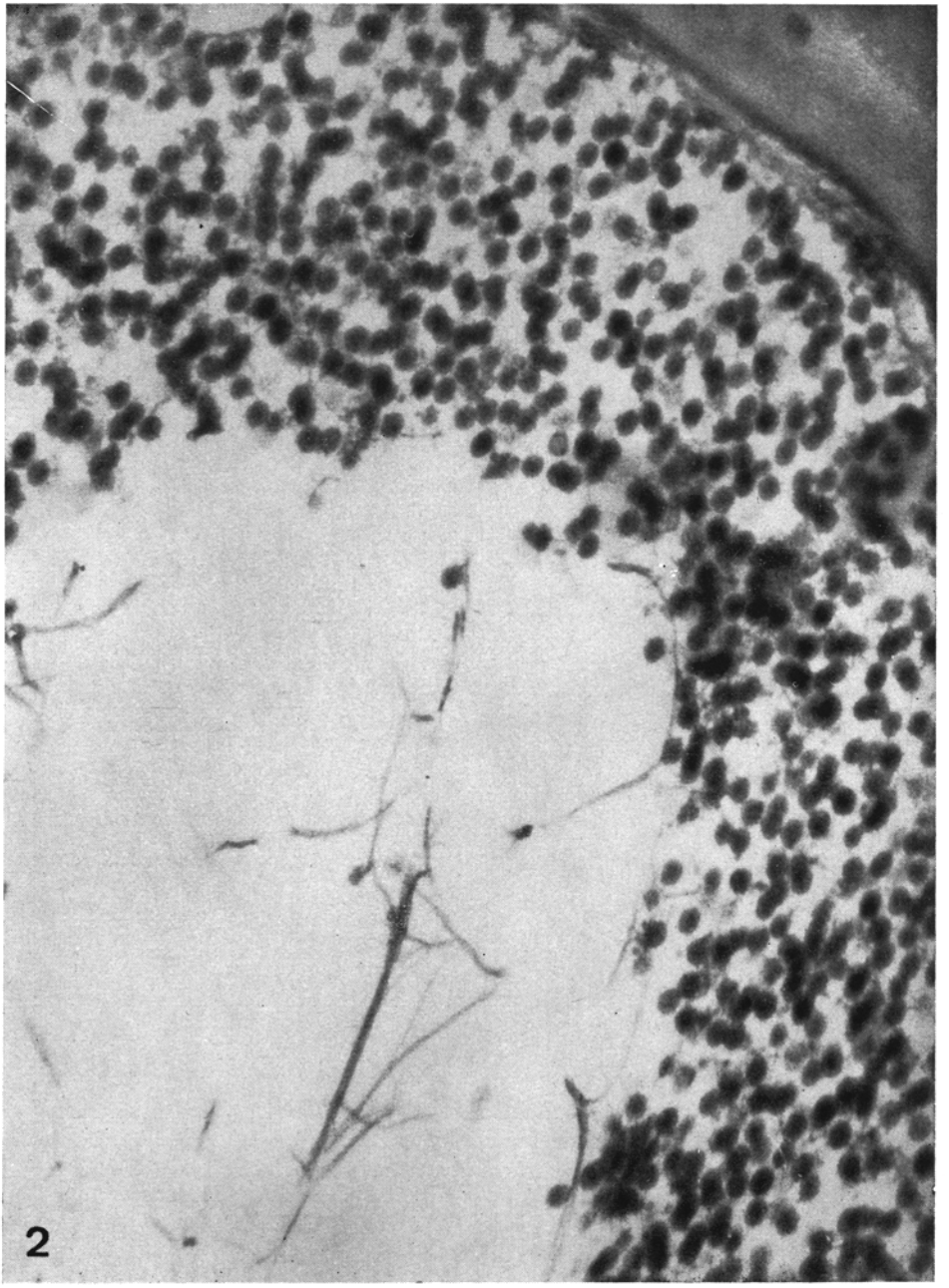


Fig. 2. Virus particles in OSD infected *Avena sativa* (50 000×)

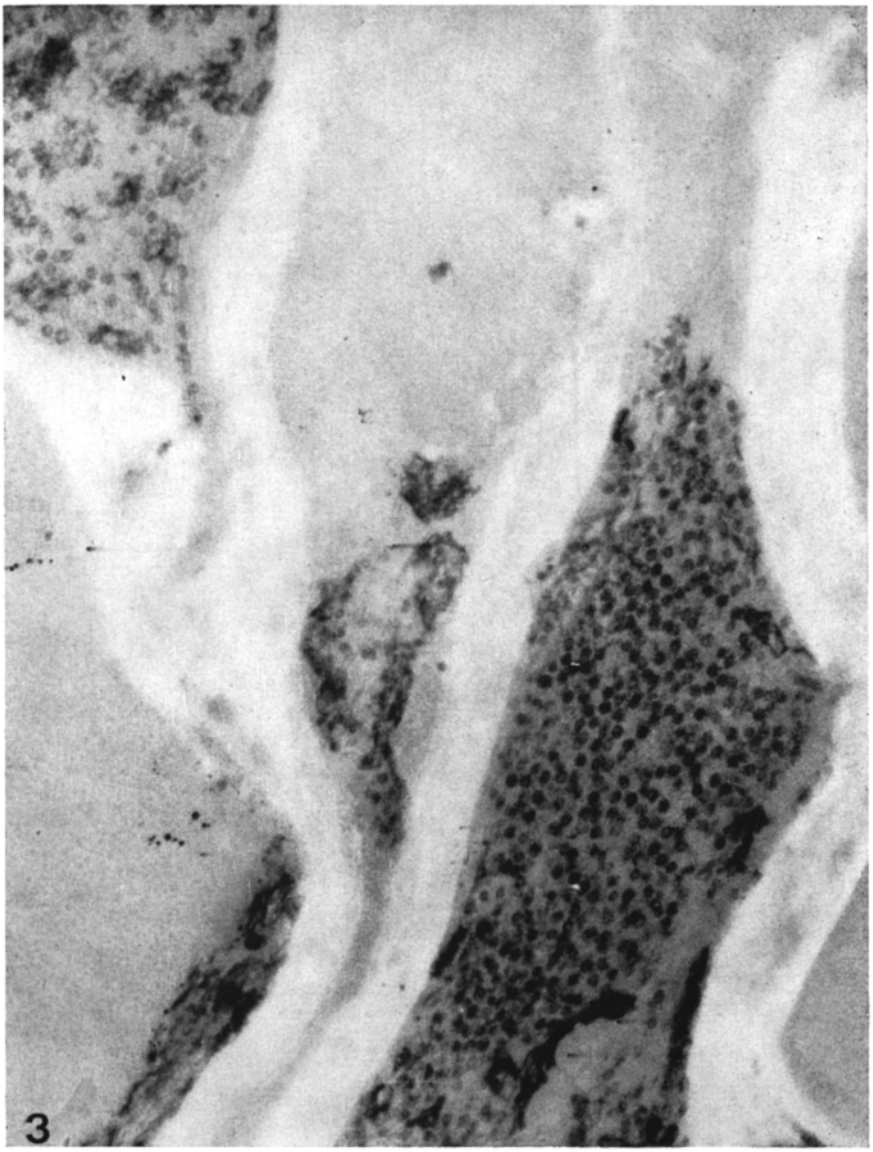
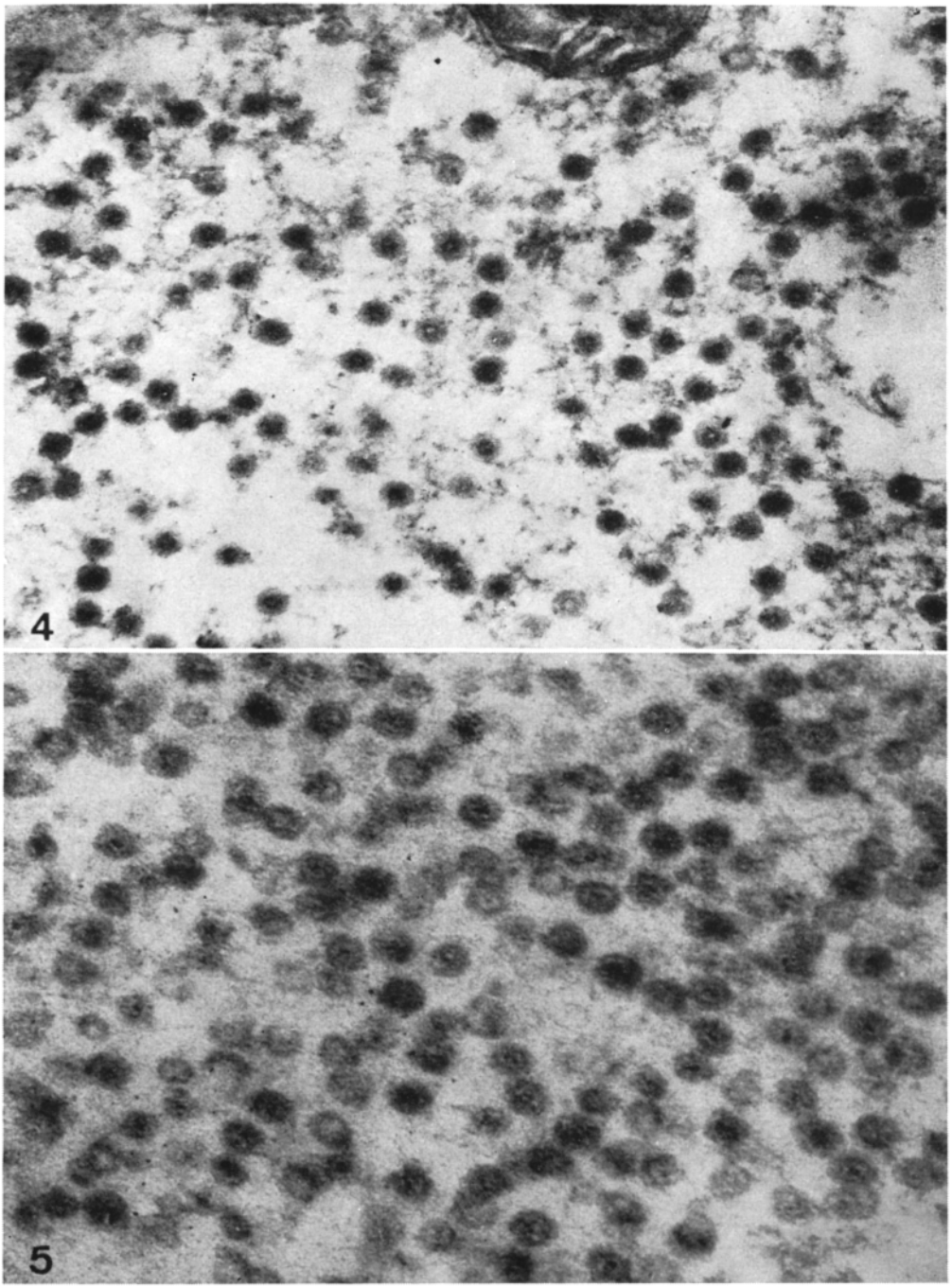


Fig. 3. Virus particles in OSD infected *Arrhenatherum elatius* (25 000 ×)



Figs. 4. and 5. Virus particles in OSD infected *Avena sativa* (60 000×) (4) and in *Arrhenatherum elatius* (90 000×) (5).