

Occurrence of viruses in asparagus (*Asparagus officinalis* L.) in North Germany



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INTRODUCTION

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RESULTS AND DISCUSSION

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Fig. 1: Asparagus stand with decline symptoms
 left: asparagus spears at harvest time
 right: asparagus fern with yellowing

Background

Asparagus growers have reported on a decline syndrome, which leads to reductions in the profitable life of asparagus plantings. The syndrome causes asparagus crops to lose their economic value within 5 to 10 years of cultivation. The decline is associated with a reduction in spear number and size, and even death of the crown (Fig. 1). Several pathogens as well as abiotic factors are believed to act individually or in concert to cause the decline. So far viruses which have frequently been detected in asparagus fields are *asparagus virus 1* (AV1, Fig 2), *asparagus virus 2* (AV2), *cucumber mosaic virus* (CMV, Fig. 2) and *tobacco streak virus* (TSV).

This survey was conducted to determine the incidence and degree of single and mixed virus infections in asparagus crops in North Germany and to ascertain the effects of plant age and variety.

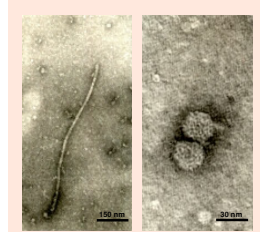


Fig. 2: Viruses infecting asparagus
 left: particles of *asparagus virus 1*
 right: particles of *cucumber mosaic virus*

Fern samples from selected commercial asparagus stands throughout Lower Saxony (Germany) were tested individually for presence of AV1, AV2 and CMV by enzyme-linked-immunosorbent assay (ELISA). Thereby the samples were randomly collected in asparagus stands differing in age. Additionally fern samples of six year old asparagus plants from a stand located in Berlin were taken to evaluate the sensitivity of three different varieties ('Eposs', 'Rambo' and 'Ramos') to a virus infection.

An indirect ELISA protocol was used to detect AV2; antibodies as well as the test system were obtained from Agdia (Linaris GmbH, Wertheim, Germany, prod. no. SRA71000). A double-antibody sandwich (DAS) ELISA was applied to detect AV1* and CMV**.

ELISA identifications were confirmed by symptom development after rub inoculation of the indicator plants *Chenopodium quinoa* Willd., *Cucumis sativus* L. and *Nicotiana tabacum* var. "Samsun" with sap extracted from randomly-selected fern samples. Indicator plants were inoculated at the 4 – 8 leaf stages.

Incidence and degree of single and mixed infections

In general, asparagus ferns of virusinfected plants did not show characteristic symptoms. Some of them exhibited chlorosis or were stunted, but these symptoms did not correlate with infection (Fig. 3). Only a sixth part of the tested plants could be addressed as virus-free (Fig. 4). An infection with a single virus was displayed by approximately half of the fern samples whereas infections with AV1 dominated. Mixed infection with two viruses were detectable in a third of the asparagus plants. An infection with CMV and AV1 occurred most frequently. None of the investigated plants indicated a triple infection nor a single infection with AV2.

Effect of plant age

Remarkable is the fact that only four months after planting, 12% of the plants were already virus-infected, and that these infections were exclusively by AV1 (Fig. 5). This frequency of infection likely reflects the level of AV1 in asparagus crowns used to establish the crops. Subsequent dispersal within a field – up to 98% within 7 years (Fig. 6) – may be caused by aphid transmission, and by mechanical transfer of virus on knives used to harvest spears and machinery used to cut down foliage. The proportion of virus-infected plants, especially mixed infections increased with the age of the asparagus crop.

Effect of the asparagus variety

No significant difference in the proportion of AV1-infection could be determined in regard to the asparagus variety (Fig. 7). In contrast there supposed to be a correlation between the susceptibility to a CMV-infection and the asparagus variety. Whereas about 80% of the fern samples of the varieties 'Ramos' and 'Eposs' were tested CMV-positive, only 42% of the variety 'Rambo' did so (Fig. 7).



Fig. 3:
 Asparagus fern with confirmed virus-infection
 left: *asparagus virus 1* (AV1)
 middle: *asparagus virus 2* (AV2)
 right: mixed infection of *cucumber mosaic virus* (CMV) and AV1

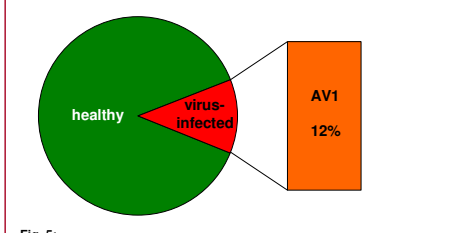


Fig. 5:
 Occurrence of viruses in asparagus plants from three selected German asparagus fields from 5 months after planting (n=60).
 single infection (CMV, AV2): 0%
 double infection (CMV/AV1, AV1/AV2 and CMV/AV2): 0%
 triple infection (AV1, AV2 and CMV): 0%

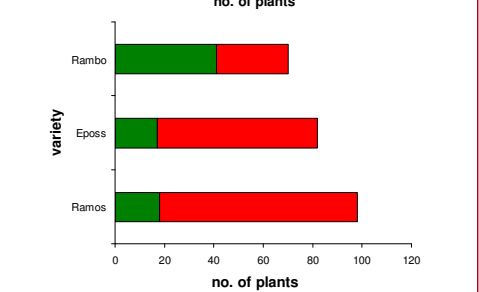
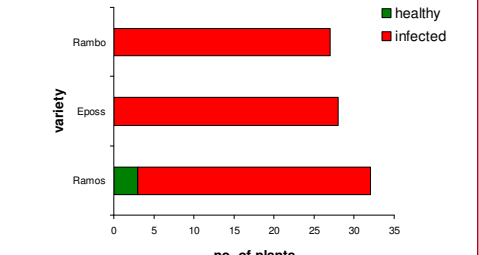


Fig. 7:
 Infection of asparagus plants from a 6-year old stand dependant on the planted variety
 top: *asparagus virus 1* (AV1)
 bottom: *cucumber mosaic virus* (CMV)

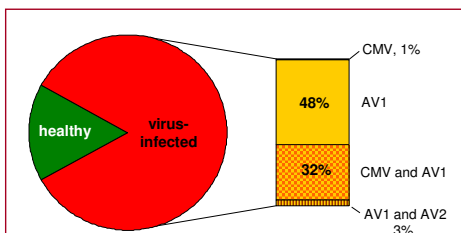


Fig. 4:
 Occurrence of viruses in asparagus plants from 20 selected German asparagus fields. (n=400).

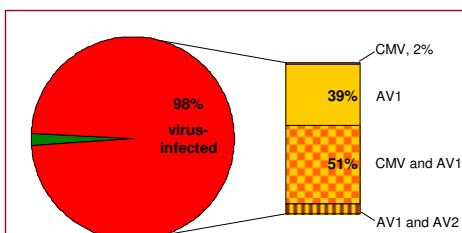


Fig. 6:
 Occurrence of viruses in asparagus plants from 10 selected 5 to 7 year old German asparagus fields (n=180).

Only 16% of the tested plants (n=400) were virus-free. A third of the plants showed a mixed infection with two viruses; none a triple infection.

The proportion of virus-infected plants increased with the age of the asparagus crop.

The susceptibility to an infection supposed to depend on the asparagus variety and the virus. Whereas "Rambo" got infected by AV1, more than half of the plants remain CMV-free.

* Specific antibodies against AV1 as well as CMV-specific antibodies were provided by Dr. Frank Rabenstein (Federal Centre for Breeding Research on Cultivated Plants, Quedlinburg, Germany)
 ** Alternatively CMV-specific antibodies were provided by PD Dr. Joachim Hamacher (University of Bonn, Institute of Crop Sciences and Resource Conservation, Bonn, Germany).