

REPORT ON THE VIIIth INTERNATIONAL PLANT VIRUS EPIDEMIOLOGY SYMPOSIUM – FIRST STEPS INTO THE NEW MILLENNIUM, AT ASCHERSLEBEN, GERMANY, 12-17 MAY, 2002

This successful and stimulating international symposium was held in the substantial and well set out conference venue, the Bestehornhaus, in the centre of Aschersleben. The symposium was well attended by 155 participants from 35 different countries from five continents. It was the eighth in the series of international symposia held every three years under the auspices of the Plant Virus Epidemiology Committee of the International Society for Plant Pathology.

The programme started on the evening of Sunday 12th May with registration and a welcoming reception in the town hall hosted by the Mayor of Aschersleben. On Monday 13th May the opening session included three brief presentations by Thomas Kuehne, the principal symposium organiser, the Mayor of Aschersleben, and Manfred Lueckemeyer representing the German Federal Ministry of Consumer Protection, Food and Agriculture. Historical accounts were provided of the town of Aschersleben and its Agricultural Research Station founded in 1920 and rebuilt after the second world war by Prof. Maximillian Klinkowski. Since 1992, the two institutes in Ascherleben (Institute for Resistance Research and Pathogen Diagnostics, and Institute for Epidemiology and Resistance) have belonged to the newly founded Federal Centre for Breeding Research on Cultivated Plants (www.bafz.de). Their current main research emphasis is on pathogen resistance and epidemiology of plant pathogens.

The opening presentations were followed by the Chairman's' address in which Roger Jones (Australia) spoke on the topic "Using epidemiological information to develop effective integrated virus disease management strategies". He stressed the dangers associated with deploying single control measures against virus diseases and the synergistic benefits that result from combining control measures with different modes of action. The types of epidemiological information needed before effective integrated management strategies can be developed for specific pathosystems were described. Integrated virus disease management strategies need to be 'tailor-made' by selecting the mix of host resistance, cultural, chemical or biological control measures most suited to each individual pathosystem. He gave examples illustrating integrated management strategies designed for viral pathogens transmitted in different ways.

The first major session was on "Virus resistance in plants". It started with invited contributions on "Durable virus resistance through conventional approaches" by Herve Lecoq (France) and "Molecular-biological aspects of virus resistance" by Jari Valconnen (Sweden). In a comprehensive review Lecoq described how different types of host resistance to viruses operate, how virus evolution can combat host resistance, and the tendency of resistance-breaking strains to be poorly competitive in mixed infection with other strains. The numbers of nucleotide changes in the virus genome required to overcome host resistance contribute to its durability. Combining cultural control measures with virus resistance approaches improves resistance durability. Valconnen described how single dominant and recessive resistance genes operate, and the way isolation and characterisation of resistance genes can provide novel insights into virus resistance mechanisms, viral synergism and the 'recovery' phenomenon. During the last two years genes controlling RNA silencing (encoding

polymerases and helicase) and a universal RNA surveillance system (encoding calmodulin-related protein) have been found in plants. The helper protein of potyviruses (HC-pro) and several other viral proteins can act as silencing suppressors.

The papers in the rest of the virus resistance session were on:- control of mite-transmitted pigeon pea sterility mosaic disease in India through viral resistance (Jones, Scotland); ability of barley yellow mosaic virus 2 to overcome the *rym4* resistance gene in barley and the pivotal role played by viral RNA1 in this (Kuehne, Germany); the outstanding performance of transgenic resistance to cucumber fruit mottle virus in cucumbers carrying viral coat protein or replicase genes (Gal-on, Israel); the behaviour of pathogen-derived resistance in transgenic plums challenged with aphid inoculated plum pox virus and exposed for 5 years in the field (Ravelandro, France); and the instability under field conditions of pathogen-derived resistance to potato virus Y in potato (Schubert, Germany). In the evening, (Monday) participants were treated to an interesting sightseeing tour of Aschersleben complete with a church organ recital.

On Tuesday 14th May there was a full day session on ‘Virus-vector interactions’, which started with an invited presentation from Edgar Schliephake (Germany) on ‘Aphid behaviour and virus transmission’. He reviewed the features of aphids (flight, dispersion, reproduction, host recognition, feeding habits, etc.) that make them well suited to transmitting viruses, surviving adverse environmental conditions and rapidly exploiting opportunities to colonise plants. The advantages and disadvantages of using different types of insect traps in epidemiological studies were discussed along with use of electrical penetration graph data to provide information about probing and virus transmission by aphids.

There followed a series of papers on:- detecting RNA-amplifiable citrus tristeza virus by squash capture-PCR in aphids visiting citrus trees (Cambra, Spain); using chimaeric viruses to determine molecular mechanisms of transmission of beet western yellows and cucurbit aphid-borne yellows viruses by aphids (Herrbach, France); and the specificity of the potyvirus helper component in aphid transmission using turnip mosaic and zucchini yellow mosaic viruses as a model (Huet, Israel). The ‘virus-vector interaction’ session continued with papers discussing:- using aphid vector resistance to control groundnut rosette virus disease in the sub Sahara (Willekens, UK); whitefly transmission of different sweet potato viruses (Valverde, USA); the relationship between cucumber vein yellowing virus and its whitefly vector *Bemisia tabaci* (Caciagli, France); genotypic variation in *Bemisia tabaci* in Africa (Abdullahi, Germany), and transmission of wheat dwarf virus by the leafhopper *Psammotettix alienus* (Manurung, Germany). In a comprehensive presentation on the relationship between thrips development and tospovirus transmission, Moritz (Germany) reported that the separation of salivary gland from mid gut during larval development is the reason why only first and early second instar thrips larvae can acquire tospoviruses.

The final two papers on the ‘virus-vector’ interaction topic were on:- festuca leaf streak virus reaching the salivary gland being responsible for its transmission by its plant hopper vector *Javesella pellucida* (Lundsgaard, Denmark), and an entertaining contribution on contact transmission of rice yellow mottle virus in rice crops by rats and cattle (Sarraf, Mali). The day (Tuesday) finished with an introduction to the Scientific Excursion to be held on the following day, and a well attended open

meeting that elected new representatives to the Plant Virus Epidemiology Committee of the ISPP, and discussed possible future symposia sponsored by the Committee.

On Wednesday 15 May the Scientific Excursion took place in which three experimental sites were visited. An explanatory excursion booklet provided useful historical background and helpful information about the work being done at the three sites which were:

1. The Institute of Horticultural Crops at Quedlinburg. Here we saw an impressive field experiment in which a large number of brassica species infected with turnip mosaic virus (TuMV) showed a diverse array of viral symptoms. TuMV-resistant brassica germplasm was demonstrated along with new TuMV resistance sources in Chinese cabbage, horse-radish, primitive forms of cabbage and *Raphanobrassica* hybrids, and breeding lines of cauliflower with resistance to TuMV. The programme of breeding different brassica species for TuMV resistance was described by the researcher involved (Reiner Kraemer) and a useful detailed explanatory handout provided.
2. At Morgenrot we saw extensive virus field trials plots belonging to the private plant breeding company "Saatzucht Joseph Breun GdbR". Here, large-scale breeding of barley for resistance to barley yellow mosaic and barley mild mosaic viruses is underway on land heavily infested with both. Susceptible and resistant responses to challenge with soil-borne virus inoculum were clearly evident in the plots.
3. At Gatersleben, we visited the genebank of the Institute of Plant Genetics and Crop Plant Research at Gatersleben. This modern genebank is one of the biggest in the world holding more than 10,000 accessions. It plays an important role as a genetic resource for plant breeders and in preventing genetic erosion in crop plants and their wild relatives.

On Thursday 16 May, the morning session topic was "Molecular and general virus epidemiology". It started with an invited presentation from Rene van der Vlugt (Netherlands) entitled "Plant virus epidemiology: facts and future". He emphasised how understanding the disease triangle and the interactions between its constituents [virus-host-environment] is essential to assess risk of epidemic development. Use of modern techniques for virus detection assist enormously in obtaining information needed to develop this understanding. He gave the recent European outbreaks of potato virus Y^{NTN} strain in potato and pepino mosaic virus in tomato as examples of where the latest molecular and immunological methods had been successfully deployed for this purpose.

This epidemiology session included a series of more molecular papers on:- molecular variation of two distinct strains of wheat dwarf virus differing in host preference and nucleic acid sequence, one from wheat and the other barley (Kvarnheden, Sweden); variations in the coat proteins of field populations of maize dwarf mosaic virus from corn (Salomon, Israel); and characterisation of Zanzibar cassava mosaic virus, a new cassava virus (Maruthi, UK). A paper by Harper (UK) described how banana streak virus disease can arise in banana plants from release stimulated by 'stressful conditions' of integrated copies of the virus sequence incorporated within the host B genome. He reported that such incorporation into the viral genome also occurs widely with other badnaviruses in several different crop plants.

More traditional virus epidemiology papers in this session described:- western flower thrips vectored outbreaks of tomato spotted wilt virus in potato (Thompson, South Africa); the aphid vector species behaviour and epidemiology of viruses infecting lettuce and broccoli crops (Ferrer, Spain); the biotic factors driving epidemics of tomato leaf curl virus in India (Colvin, UK); the epidemiology and control of carrot virus Y (Latham, Australia); the current continent-wide position with the African pandemic of cassava mosaic virus (Legg, Uganda); and spread of little cherry disease (Eppler, Germany).

On Thursday 16 May the afternoon session topic was “Dynamics of virus spread”. Mike Thresh (UK) provided a comprehensive invited review of spatial patterns of virus spread. He described (with examples) the influence on spatial virus pattern of wind direction, wind breaks, hedgerows, headlands, contour banks, row spacing, plant density, irrigation channels, field size and shape, field aspect and undulation, plot size and shape, etc. He provided examples of random, clumped and systematic patterns in the distribution of diseased plants for scenarios with soil-borne and aerial vectors, and with internal or external virus infection sources. He also discussed different types of virus infection gradients. These spatial patterns and gradients influence the effectiveness of isolation and other approaches to virus control by an appropriate disposition of planting's to prevent or delay virus spread.

Then, papers followed on:- spread of iris yellow spot tospovirus by *Thrips tabaci* in onion crops (Gera, Israel); decreasing spread of tomato spotted wilt virus by thrips in thrips-resistant pepper (Maris, Netherlands); modelling tomato spotted wilt virus epidemics in potatoes (Jericho, Australia); and the epidemiology of several viruses in different crops in the Ukraine (Polischuk, Ukraine). Thackray (Australia) described a well-validated simulation model that uses pre-growing season rainfall to forecast aphid outbreaks and barley yellow dwarf virus epidemics in a typical Mediterranean-type climate. Predictions for date of aphid arrival, amount of virus spread, yield losses and the need for early insecticide sprays are provided.

At the conference dinner that followed (thursday evening), participants were treated to a delicious multiple course meal + a choice of wines, followed by typical folksinging by singers from the Harz mountains complete with yodelling and audience participation. Presentations were made to Thomas Kuehne to thank him and the Aschersleben team for all the hard work in organising such a successful conference and to Gerhard Proeseler for his role in the conference organisation and to wish him well in his retirement. The evening was rounded off with dancing to music played by a local popular music group. An excellent evenings' entertainment was had by all.

On Friday 17 May, the final session of the conference dealt with “Strategies for virus control”. Francisco Morales (Colombia) set the scene with an invited presentation on “ecology and epidemiology of whitefly-transmitted viruses in Latin America”. This was a “big-picture” paper that started by outlining which virus diseases are currently most important economically on major crops grown from Mexico and the Caribbean islands in the north right through to the southern cone of South America. He emphasised the widespread damage caused by whitefly-transmitted begomoviruses and discussed modelling studies using the FloraMap program with data from 304 geo-referenced points that help explain their distribution. The key to occurrence is climatic conditions that favour their vector *Bemisia tabaci* – in particular a dry season

of at least 4 months and a mean temperature above 21°C for the hottest month of the year.

The presentations on control strategies that followed dealt with:- extension and uptake by farmers of single control measures versus integrated control approaches for managing cassava mosaic virus (Sseruwagi, Uganda); using cross protection with mild cassava mosaic strains to prevent infection by severe ones in a post epidemic situation (Owor, Uganda); using resistant cultivars and phytosanitary measures to control sweet potato virus disease caused by mixed infection with sweet potato chlorotic stunt and sweet potato feathery mottle viruses (Gibson, UK); successful breeding of tomato resistant to tomato leaf curl virus (Muniyappa, India); hypersensitive and susceptible responses of rootstock's to infection with prunus necrotic ringspot and prune dwarf viruses (Lankes, Germany), and successful use of physical barriers, neem oil and Bion to control spread of potato virus Y in seed potatoes (Legorburu, Spain). In a talk addressing the important issue of how to control viruses in organic crops without access to herbicides or pesticides, Doring (Germany) demonstrated good suppression of spread of potato virus Y using straw mulch groundcover to decrease aphid vector landing rates in organic seed potato production.

One of the very important features of the symposium not mentioned above was the large number of interesting posters, more than 100 posters in total on a very diverse array of topics. In particular, the posters linked to the session topic "Molecular and general virus epidemiology" was most impressive in both size and content. They consisted of 60 different posters addressing a very diverse set of epidemiological themes, confirming that plant virus epidemiology is alive and well in the new millennium!

The conference ended with an open discussion involving contributions from invited speakers and the audience on three topics:- likely virological consequences of further spread of the B type of *Bemisia tabaci* within Africa; future prospects for deployment of plants with pathogen-derived transgenic virus resistance in different parts of the world; how to use limited financial resources to best effect when funding epidemiology research; and how best to foster a partnership of mutual benefit between researchers involved in molecular laboratory research and those involved in practical field epidemiology studies.

This eighth in the series of triennial International Symposia on Plant Virus Epidemiology was not only scientifically stimulating but also very efficiently organised. It successfully maintained the high standards set by past meetings of the International Virus Epidemiology Group. The weekend 'Spring Festival' that greeted participants on arrival at Aschersleben, with street entertainment and a throng of happy people, the warm spring weather and sunshine every day, the spring flowers and trees out in blossom, and the many attractive traditional-style German buildings in the town all helped to provide an ideal 'backdrop' to the event.

The Mayor of Aschersleben who graciously provided the reception and facilities, the German organising committee, and especially Thomas Kuehne and the staff of the two Aschersleben Institutes (Institute for Resistance Research and Pathogen

Diagnostics, and Institute for Epidemiology and Resistance) are to be congratulated warmly over a job well done.

Roger Jones, 31/5/02