

## First PVEN Workshop Summary

The Plant Virus Ecology Network, an NSF-funded Research Coordination Network, held its first workshop at the Kellogg Convention Center on the campus of Michigan State University, East Lansing, Michigan on 19-21 March 2008. PVEN participants present were; Akhtar Ali, Juan Manuel Alvarez, Yiming Bao, Nilsa Bosque-Pérez, Steven Castle, Ian Cooper, Christian Delgado, Siobain Duffy, Denis Fargette, Karen Garrett, Lava Kumar, Jiban Kundu, Allen Miller, Charles Mitchell, Rick Nelson, Israel Pagán, Sunny Power, Valerii Polischuk, Nancy Robertson, Marilyn Roossinck, Mark Tepfer, Mike Thresh, René van der Vlugt, Anna Whitfield, John Wylie, Carolyn Malmström, Ulrich Melcher and Abbie Schrottenboer

Dr. Doug Buhler, Associate Director of the Michigan Agricultural Experiment Station welcomed attendees. Carolyn reviewed workshop details and policies. Particularly, it was stressed that attendees should feel free to discuss science without concern about another attendee misusing that information. Ulrich related the process that led to NSF funding of this Network. Carolyn made a presentation of the goals of PVEN based on the proposal that resulted in its funding. These were: developing a nucleus of international plant virus ecology community, developing research agenda and resources; expanding plant virus ecology community; and communicating with broader society. She also listed some questions that could guide inquiry from an ecological perspective: what processes determine species distributions and biodiversity patterns?; what roles are there in the physico-chemical functioning of ecosystems; what's the interaction between biology and land use changes?

At this point, the participants each presented their research interests relevant to PVEN to the assembled group. Thereafter, there was directed discussion of what participants would like to see as goals of the meeting. Of concern, to at least some attendees were definitions of the following terms in plant virus ecology: "emerging", "diagnosis" vs. "detection", "fitness", "millennium assessment" and "ecosystem services". Science topics thought of particular importance included: the influence of intraspecies diversity of vectors and viruses on transmission and other processes; host plant resistance; complementation and competition; invasive species of viruses, plants and vectors; the plant itself as ecosystem; ecological differences along the agricultural to natural ecosystem gradient. Infrastructure improvements needed included databases, detection and diagnostics, application of fitness modeling. Relative to the network itself, various groups to which PVEN could reach out to recruit further participants were listed; the benefits of establishing a Wiki site were discussed; the size of future workshops and the career demographics of attendees were concerns.

The afternoon of 19 March began with a session led by Denis on Paleoeecology and Virus Evolution as one of several key questions in plant virus ecology research. Denis explained that despite large increases in our understanding of mechanisms affecting virus evolution, there have not been many advances in

determining the time scales of evolutionary events. Methods that can be, and have been, used to date apparent evolutionary events were briefly reviewed. Siobain discussed establishing rates of evolution and stressed that molecular clocks do not necessarily tick uniformly due to periods of adaptation and periods of stasis. Assumptions made in phylogenetic inference were described and similar rates of nucleotide substitution were seen for a diverse variety of virus groups. Marilyn explored with the term paleoecology.

The second part of the afternoon examined questions of vectors and ecology and was led by Anna and summarized by Juan Manuel. Nilsa discussed the influence of virus-induced changes of the plants on the behaviour of aphid vectors. Particularly emphasized were the alterations of plant volatile production that direct the aphids to infected tissue. Steven C. addressed differences in the degree of dependency of virus transmission on particular species of vectors and suggested that the mode of transmission was an important factor. The afternoon concluded with a session with discussions of results on posters brought by various attendees.

The 20 March first morning session covered questions of the ecological interactions among plants and viruses. It was led by Sunny with presentations by Karen and Charles. Karen explained the idea of ecosystem services. Charles delineated many of the factors that can alter the picture of plant virus interactions. Infrastructure was the topic of the second morning session. Ulrich reported on recent development in planning for National Ecological Observatory Network (NEON) in relation to microbes. Yiming then reviewed available databases on viruses and what information they contained and René described a database that was being constructed in the Netherlands.

In the afternoon, the group discussed what topics it would like to break up into to consider what actions. The group decided that science ideas for possible write-up into manuscripts should be discussed first as topics before deciding on writing tasks. After considerable discussion and rearrangement of topics, it seemed that the largest part of the attendees wanted to discuss topics related to the agriculture-natural continuum and emergence and evolution in that context. For discussion purposes, this group split into two sub-groups based on birth date days. Another one-third of the attendees preferred to examine intraspecies diversity and its effect on transmission.

[Here UM could use help. He has no notes of the two other discussions.]

The discussion in the Willy Room considered emergences, variation, disappearances, and several larger questions. One figure mentioned was that 80% of emergences are new introductions of viruses into naïve areas, for which emergences no adaptations are needed. Mutations become fixed both when there are host shifts, providing large bottlenecks, and by vector transmissions in which few particles are transmitted. Climate change affects emergences by extending or contracting ranges of viruses, hosts and vectors and by changing what is planted. Getting out of the first infected plant after landing seemed highly important for emergence. The main discussion around variation was about

speciation: potyviruses and CMV are roughly equally well distributed among plant hosts, but one consists of a large number of species, while the other is a single species of viruses: why?

The workshop reconvened in plenary to report on break out discussions and then broke up again to discuss infrastructure issues. Databases, NEON, and joint publication were the topics of this second round of discussion sessions. Relative to databases, mechanisms were discussed that might encourage submitters of data to GenBank to provide more information about the source of isolation of a virus sequence. Amalgamating existing archival knowledge about virus distributions even if not associated with a sequence was also discussed and deemed to require funding. The problem of continuing databases after establishment was acknowledged. The NEON group came up with an outline of a message from PVEN to NEON explaining what information would be useful to PVEN scientists. The joint publication discussion centered on plant resistance and its ecological influence.

On the final morning, attendees heard two presentations on scientific outreach. One was from Robin Buell, a former TIGR genomicist who has joined the MSU faculty. She explained how she worked in outreach into her efforts in plant pathogen genomics. The second was from Cyrus Miller of the Impression 5 Science Staff. Impression 5 is a children's science museum in Lansing MI and is under contract from PVEN to develop exhibits that excite youngsters about viruses in particular and science in general.

The next meetings were discussed. Possibilities raised for the 2009 workshop were Italy, Kansas, Oklahoma. For 2010, attendees decided to accept the invitation to hold a joint meeting with the International Plant Virus Epidemiology Symposium that will be held at Cornell University around June 21. Participant Stuart Gray, not present at the workshop, will be the organizer with several PVEN members assisting. Melcher volunteered to be the official liaison with PVEN. That this meeting would occur in grant year four was mentioned. There will be time to resolve this issue.