INTERNATIONAL NEWSLETTER ON PLANT PATHOLOGY

ISPP Newsletter 45 (8) August 2015

News and announcements from all on any aspect of Plant Pathology are invited for the Newsletter. Contributions from the ISPP Executive, Council and Subject Matter Committees, Associated Societies and Supporting Organisations are requested.

Editor: Daniel Hüberli (E - mail)

Subscribe to the ISPP Newsletter by joining the ISPP mail list

In this issue:

July Phytopathology Focus Issue to address emerging, re-emerging plant diseases

The history of plant pathology is closely tied to plant diseases that have changed the course of human history. The Irish potato famine, caused by late blight of potato, resulted in the starvation and death of millions of people and one of the most influential human migrations in history. Other plant diseases have impacted quality of life in myriad ways. The advent of fungicides, clean seeds, host resistance, and the development of a plethora of other techniques, has diminished the impact of plant diseases. However, impressive advances in modes of rapid transport have not only increased global trade and human migration, but also augmented the risk for anthropogenic invasions of plant pathogens. As a consequence, and possibly aggravated by climate change, many historical and contemporary diseases are emerging as threats to modern agriculture and food security. These emerging diseases are not only important in global crop production, but also pose severe risks on a local level, especially on small farms in developing countries.

This Focus Issue of Phytopathology contains a collection of peer-reviewed research articles, invited reviews and perspective articles on an assortment of emerging and re-emerging diseases caused by bacterial (3 papers), fungal (6 papers), oomycete (5 papers), and viral plant pathogens (3 papers). These diseases cover a range of crops including annual field crops and perennial tree crops, and vegetables, across five continents.

(Phytopathology News)

Spread of introduced viruses to new plants in natural ecosystems and the threat this poses to plant biodiversity

Biodiversity is endangered in many regions of the world, with loss of native plant species a growing concern requiring a major focus on conservation measures. However, despite their potential to invade and damage large tracts of pristine, undisturbed native vegetation, the threat posed by newly introduced viral pathogens to native plant biodiversity has been ignored almost completely. The intent of this article is to awaken worldwide interest in undertaking research activities that provide a comprehensive understanding of the threat posed by introduced viruses to natural plant ecosystems and biodiversity. New encounters involving viruses and plant species are becoming increasingly common at the agro-ecological interface between managed and natural vegetation. This is because of virus movement in either direction associated with increasing human activity, such as agricultural expansion, intensification and diversification to address food insecurity, and inadvertent virus introductions associated with ever increasing international trade in plants and plant products. Also, inadvertent introduction of more efficient virus vectors often exacerbates spread of introduced viruses to previously uninvaded plant species at vegetation interfaces. Viruses are known to host shift more easily than other pathogen types with more complex genomes and almost 50% of all emerging plant pathogens are viruses. In response to the altered circumstances when they invade new species, generalist viruses can readily undergo genomic changes that allow them to survive within their new hosts and spread to other members of the same species.

Native plants do not grow as stands of genetically identical plants of the same species exhibiting uniform virus

susceptibilities, but as mixed species communities exhibiting between species diversity. Newly introduced generalist viruses are the kind of virus likely to pose the greatest threat to the communities of native plants they invade. Virus infection can alter the species composition and dynamics of plant communities composed of species mixtures by decreasing the fitness of infected species within the plant population. This is capable of altering species composition drastically in favour of non-host species. Also, widespread virus infections causing mild symptoms in one species in a mixed-species population can provide a significant reservoir for virus spread to more sensitive species, which, once infected, decline due to lack of fitness. There is an urgent need for enhanced awareness by conservation authorities, and wild flower and tourist industries, over the importance of protecting native plant communities from invasive virus diseases, and to ensure that international quarantine authorities are kept informed over possible entry of viruses capable of damaging natural vegetation.

A new opinion piece by R.A.C. Jones and B.A. Coutts published in Molecular Plant Pathology in August 2015 (vol. 16, pp. 541-545).

See: http://dx.doi.org/10.1111/mpp.12268

(Roger Jones)

What is the risk to crops of plant pathogenic bacteria in open irrigation systems?

A review by J. R. Lamichhane and C. Bartoli "Plant pathogenic bacteria in open irrigation systems: what risk for crop health?" was published in August 2015 by Plant Pathology (vol. 64, pp. 757-766). This follows a similar review by Zappia et al. on fungi and oomycetes in open irrigation systems (see Zappia et al. (2014) Fungi and oomycetes in open irrigation systems: knowledge gaps and biosecurity implications. Plant Pathology 63, 961-972). The abstract is as follows:-

The current global area equipped for irrigation provides 30-40% of the world's gross food output. Water used for plant irrigation may harbour plant pathogens and foster their spread. This represents a serious risk for crop health, with heavy socio-economic consequences. More specifically to plant pathogenic bacteria (PPB), a range of species have been reported from irrigation systems and their potential role in epidemic development has long been recognized. However, only a few studies have been performed to date on the ecology of PPB in the context of water habitats. Consequently, current knowledge of the biology, ecology and epidemiology of PPB in irrigation water is poor. In light of this, an attempt is made to describe the most relevant information concerning the role of open irrigation systems in the survival and dissemination of PPB throughout the range of cultivations and the possible consequences for crop health. The information described in this paper will help to improve understanding on the overlooked role of irrigation water as a reservoir of PPB.

See: http://dx.doi.org/10.1111/ppa.12371

Fairy-floss ice spun by fungus

"Hair ice" was first described almost 100 years ago in 1918 by geophysicist and meteorologist Alfred Wegener. It grows under very specific conditions in long, thin threads like hair or fairy-floss from the rotten branches of certain trees. At that time, Alfred proposed that the unusual ice formation was probably due to fungus growing on the damp and decomposing wood.

A team of researchers from Switzerland and Germany have analysed the ice and determined that its peculiar shape is indeed formed by a fungus which they have identified to be Exidiopsis effusa. The discovery was difficult as the "hair ice" grows mainly in broadleaf forests between the latitudes of 45 and 55 degrees north, and only grows at night and melts when the sun rises.

The research was led by Christian Matzler from the Institute of Applied Physics at the University of Bern in Switzerland, who in 2005 worked with Uppsala University microbiologist Gerhart Wagner to explore the fungus theory further. The discovery has been published in Biogeosciences: http://dx.doi.org/10.5194/bg-12-4261-2015.

https://www.youtube.com/watch?v=5cRngAm8uqA

Read more.

Rice disease-resistance discovery closes the loop for scientific integrity

When disease-resistant rice is invaded by disease-causing bacteria, a small protein produced by the bacteria betrays the invader. Upon recognizing that protein, the rice plants sense that a microbial attack is underway and are able to mount an immune response to fend off bacterial infection, reports a research team led by the University of California, Davis.

Identification of the tiny protein, called RaxX, holds promise for developing more disease-resistant crop varieties and therapeutic treatments for blocking microbial infections in both plants and animals, said the researchers, who found particular satisfaction in this discovery, two years after retracting the announcement of

a similar find.

Researchers discovered that the RaxX protein was present in at least eight species of the disease-causing Xanthamonas bacteria that are known to attack rice as well as maize, cassava, sugar cane, tomatoes, peppers, wheat, alfalfa, onions, banana and citrus. "Our research team is delighted to announce the discovery of the RaxX protein, a new class of microbial signalling molecules," said Pamela Ronald, a professor in UC Davis' Department of Plant Pathology and Genome Center, who directed the study. Her laboratory is currently investigating the role of RaxX during bacterial infection of rice in the absence of the immune receptor.

The researchers have noticed that RaxX closely resembles a class of plant signalling factors that promote growth and modulate the immune response. They suspect that the bacteria could be mimicking these natural plant-signalling factors to inhibit the plant immune response and thereby enhance the competitiveness of the bacteria. In the long term, the researchers hope to use this information to develop new strategies to prevent infection in various crops.

See: http://dx.doi.org/10.1126/sciadv.1500245

(EurekAlert, 24 July 2015)

Organic seed coating for alfalfa helps prevent some soilborne diseases

U.S. Department of Agriculture (USDA) scientists have found that a natural seed coating can protect alfalfa against some soilborne diseases. Alfalfa is a $10 billion-a-year crop in the U.S., but producing it can be a challenge. Farmers in the Midwest often plant it early in the spring when the soil is cold and damp. That makes the seeds vulnerable to a number of soilborne diseases.

To minimize the damage, most alfalfa seeds are coated with a fungicidal treatment. But the treatment, mefenoxam, is ineffective against the pathogen causing Aphanomyces root rot (ARR), which is common to Midwestern soils.

Demand for organic alfalfa for organic dairy operations also is increasing, and alfalfa treated with a fungicide cannot be labelled as organic. Many organic dairy farmers would like to expand but may face a roadblock due to a lack of available organic feed, according to Deborah Samac, a plant pathologist in the Agricultural Research Service's (ARS) Plant Science Research Unit in St. Paul, Minnesota.

Samac wanted to see if coating alfalfa seeds with a naturally occurring mineral would protect them from soil diseases, including ARR. The mineral, zeolite, comes from degraded volcanic rock, has antifungal activity, and qualifies as an organic soil treatment. Samac also wanted to assess zeolite's effects on the health of plant roots and beneficial soil microbes.

She and her colleagues grew plants with three different seed treatments and inoculated them with the types of pathogens that attack alfalfa roots. The seed treatments included a control with no fungicide, mefenoxam-treated seeds, and commercially available zeolite-coated seeds designed for organic alfalfa production. They also repeated the process in soils collected from 12 Minnesota alfalfa fields to assess the treatment's effectiveness in soil naturally infested with pathogens.

The results showed that the mineral coating was as effective as mefenoxam in protecting seeds from most soil pathogens, but unlike mefenoxam, zeolite protected the seeds from ARR. It also did not inhibit production of healthy roots or beneficial microbes in the soil. The coated seeds need to be evaluated further, but the findings show they could prove useful in both conventional and organic alfalfa operations, Samac says. The results were published in Plant Disease in May 2015.

Read more in the July 2015 issue of AgResearch magazine.

(Dennis O'Brien)

Plant diseases and their management in organic agriculture - APS Press book

Several textbooks have been written on the principles and practice of organic farming. Although many research papers have been published about plant diseases and their management in organic production systems, to date no textbooks have been available on this topic until the appearance of "Plant Diseases and Their Management in Organic Agriculture." This textbook is the result of over ten years of research and teaching organic agriculture and disease management by the editors (Maria R. Finckh, Ariena H. C. van Bruggen, and Lucius Tamm) and an international team of scientists and practitioners from Europe, North America, Middle and Latin America, and Africa.

Plant diseases on organic crops cannot be managed curatively, and an integrated systems approach to disease management is indispensable. In this book the agricultural system effects on plant diseases are emphasised. The book starts with a general introduction (part 1) into the history and principles of organic agriculture, regulation and certification worldwide, and presents the reasons for writing the book. In part 2, general principles of organic plant production are described, as well as their effects on microbial communities,

pathogen fitness and plant resistance. This is followed by current organic practices for the production of annual and perennial crops in the field and vegetable crops in the greenhouse. An overview of common plant diseases in organic agriculture is given in part 3, including detailed descriptions of airborne diseases, soilborne diseases caused by fungi and bacteria, diseases caused by nematodes, and vector-borne diseases. In part 4, plant disease management strategies are presented, with chapters on crop rotation, water management, biodiversity enhancement, breeding for disease resistance, seed health management, direct control of airborne and soilborne diseases, and food chain management. The book ends with case studies on organic disease management of specific crops (part 5), specifically potatoes, small grain cereals, rice, temperate legumes, vegetables, apples, grapes, bananas, and coffee.

"Plant Diseases and Their Management in Organic Agriculture" is an important resource for any researcher, student, or practitioner wanting to learn about plant diseases and their management in organic agriculture. It is not only of value for people interested in organic farming but will also be an inspiration for innovative studies and applications of ecological principles in other agricultural systems. It is a much needed addition to the textbooks on ecological agriculture and agroecology used by students, researchers and extension staff as well as for interested farmers, consultants, and other practitioners involved in organic agriculture. The book offers valuable, detailed information that helps users understand the effects of farming systems on plant diseases, nutrients, soil fertility management, habitat management, and biodiversity. Many colour photographs illustrate organic crop production practices and potential plant disease symptoms, aiding the readers in visually recognising a wide range of diseases that may affect their crops.

A detailed description of this book can be found on APS Press at:
http://www.apsnet.org/apsstore/shopapspress/Pages/44761.aspx

(Ariena H. C. van Bruggen, University of Florida, USA)

Proceedings of the 7th IUFRO meeting on Phytophthoras in Forests and Natural Systems in Patagonia, Argentina

The proceedings of the 7th IUFRO meeting on Phytophthoras in Forests and Natural Systems held in Patagonia, Argentina, during 10-14 November 2014 (see meeting overview) can now be downloaded as a PDF, along with all the previous proceedings, from http://forestphytophthoras.org/proceedings.

(Everett Hansen)

Newfound groups of bacteria are mixing up the tree of life

Researchers at the University of California, Berkeley, have identified more than 35 new groups of bacteria, clarifying a mysterious branch of the tree of life that has been hazy because these microbes could not be cultured and studied in the lab.

The new groups make up more than 15% of all known groups or phyla of bacteria and include the smallest life forms on Earth, microbes a mere 400 nanometers across. The number of new bacterial phyla is equal to all the known animal phyla on Earth.

The scientists, who recently also identified nine new groups of microbes known as Archaea, see these new additions to life on Earth as a sign that the accepted tree of life - a division into the three domains of eukaryotes, which includes animals and plants, bacteria and Archaea - needs to be revised.

"This is a new view of the tree of life," said lead author Jill Banfield, a professor of earth and planetary science and of environmental science, policy and management. "These new groups of bacteria and Archaea are changing our understanding of the number and arrangement of branches on the tree of life." Graduate student Christopher Brown, Banfield and their colleagues reported the discovery online in the journal Nature.

Read more.

(Berkeley News, 15 June 2015)

Acknowledgements

Thanks to Everett Hansen, Grahame Jackson, Roger Jones, Greg Johnson, Ariena van Bruggen, and Peter Williamson for contributions and photos.