



# ***Emerging plant health risks: objectives of the Colloquium***

Mike Jeger, Chair EFSA PLH Panel

# EFSA and emerging risks

“The Authority shall establish monitoring procedures for systematically searching for, collecting, collating and analysing information and data with a view to the identification of emerging risks in the fields within its mission” (art. 34.1 Reg. (EC) No 178/2002).

“...an emerging risk (ER) to human, animal and/or plant health is understood as a risk resulting from a newly identified hazard to which a significant exposure may occur or from an unexpected new or increased significant exposure and/or susceptibility to a known hazard.” (EFSA Scientific Committee, 2007).

# Emerging plant health risks

“...an emerging risk (ER) to **plant health** is understood as a risk resulting from a newly identified **pest/harmful organism** for which a significant **likelihood of introduction and spread** may occur or from an unexpected new or increased significant **likelihood of introduction and spread** and/or susceptibility to a known **pest/harmful organism** .”

# Emerging plant health risks

New plant pest (new species/ new strain)	New/ modified pathway	Increased/ modified crop susceptibility	
	X	X	Listed quarantine pests
	X	X	Pests recorded in other countries not listed as quarantine
X		X	Species not recorded as harmful changing behaviour
X	X	X	Unknown/new species

# Priorities and signals

- EU IAI Quarantine pests & EPPO Alert List
  - changes in “exposure” (probability of introduction and spread), e.g. due to new hosts, modifications of agriculture/forestry practices, spread to new countries, movement on new pathways (high priority)
- EU IAI quarantine pests (Lower priority)
- Quarantine pests in other country lists (Changes)
- Pests on important EU crops in areas with similar climates, areas with new trends of introduction (e.g. East Asia)
- New pests on derogated pathways/new pathways
- Lag phase studies
- Evolving genera (e.g. *Phytophthora*)

- Commodities
  - FAOSTAT, EUROSTAT, national statistics, trade/customs data, FVO
  - Trends and retrospective analysis
  - Difficult to find new information quickly from this
    - Data too aggregated, EUROSTAT/FAOSTAT too late
    - Need trade/customs information
- Pests
  - EPPO/NAPPO information service
  - CABI information services
  - Scientific and technical literature, growers/trade infos
  - Media screening / Google news /Web searches
  - Interception/outbreak/establishment trend analysis

# Needs and challenges

- To rapidly, efficiently and robustly identify/predict emerging plant health risks as early as possible.
- To assess emerging plant health risks, under time and data constraints.
- To communicate timely with risk managers and to provide them with sufficient scientific support to put in place effective risk mitigation strategies.

# Scientific Colloquium objectives

Following discussion at EFSA Panel on Plant Health plenary meetings, the EFSA Scientific Colloquium 16 on the identification of emerging plant health risks has been organised:

- to openly debate key scientific issues related to the identification of emerging plant health risks;
- to provide inputs for development of EFSA's methodological framework for identification of emerging plant health risks.



## Opening Plenary session

**Four discussion groups (DG) with focus on drivers of emerging plant health risks at different scales:**

- ☐ DG 1 – Changes in pests/vectors/plants and their interactions
- ☐ DG 2 – Changes in agriculture/forestry practices
- ☐ DG 3 – Changes in trade/food consumption/land use
- ☐ DG 4 – Climate change

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ORIGINAL PAPER

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Don Frohlich · Siti Subandiyah · Shigenori Ueda

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**Abstract** *Bemisia tabaci* is a species of sap-  
sucking insect belonging to the Aleyrodidae and a  
commonly known as whiteflies. The species is ma-  
king a complex of distinct genetic groups which  
strong geographic pattern to their genetic sta-  
tus. Two members of this complex known as the  
Mediterranean and the Asian biotypes have proven to be particularly  
spreading with the aid of trade in ornamentals  
well beyond their home ranges across the Me-  
diterranean Basin, Middle East and Asia. This  
study uses DNA microsatellites to identify  
biological invasion this time involving a E-

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## ZURBRUGEN ET AL.

### Emerging Viral Diseases of Tomato Crops

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And diseases are an important limiting factor in many non-reduction systems. Because natural products are

PLOS one

## An Extensive Field Survey Combined with a Phylogenetic Analysis Reveals Rapid and Widespread Invasion of Two Alien Whiteflies in China

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## Abstract

**Background:** To understand the processes of invasions by alien insects is a pre-requisite for improving management. The whitefly *Bemisia tabaci* is a cryptic species complex that contains some of the most invasive pests worldwide. However, extensive field data to show the geographic distribution of the members of this species complex as well as the invasion by some of its members are scarce.

[illegible]

**Conclusions/Significance:** Invasions by some members of the whitefly *B. tabaci* species complex can be rapid and widespread, and indigenous species closely related to the invaders are replaced.

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consider an emerging virus to be used or appeared to occupy and (Gilbertson 2008). Emergencies are those that were previously ill, emerging viruses are endemic in a certain niche (the vector, the host, or the

## THE CHRISTMAS INVASION

The cheerful leaves of the poinsettia could be hiding an unwelcome visitor. **Rex Dalton** goes in search of the whitefly, a potentially devastating pest.

**F**or many Americans, the freer access to chlorophyll is a welcome change of pace from the world of pesticides. But for some entomologists the annual flood of red foliage is not such a welcome sight. When Timothy Denno fills up a petri dish with a few red maple leaves, he says, "it's like pulling a trigger and watching more over the next couple of months—he's not admiring the pop of color with an eye for beauty, he's sitting in his barbershop, looking for little greenish-white burlers, the signs of agricultural chaos."

giant at the University of Arizona, Tucson, hints the state's flower stalk searching for whittly (*Bemisia tabaci*) on the poinsettias shipped in for the festive holidays. In December 2004, his horticultural greenhouse work paid off in a Tucson market with the first US identification of the whittly variant in question — the pesticide-resistant Q-biotype. The following year, the Q-biotype was found in stores across Arizona, spurring a nationwide survey that found

The severity of the drought is whitely spotlighted by the impact on the rice crop. Robert Galois, director of the University of California, Davis, says damage caused by whitely mites is "the worst [agricultural pest] problem in regions of Africa, Asia and South America." The flies' increased numbers have also caused crop damage from drought – "much actually prefer things hot and dry – make them a grave threat both in parts of the developing world. Elsewhere, international trade has put tomatoes in Japan, and wheat in Australia, at increased risk."

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## Sudden larch death

Clive Brasier and Joan Webber

An aggressive and unpredictable fungal pathogen is devastating larch plantations in Britain. Its remarkably broad host range, and the possibility of further geographical spread, give heightened cause for concern.

For more than a decade, a stream of invasive tree pathogens has been arriving in Europe and North America<sup>32</sup>. Among the more damaging and unpredictable arrivals is *Phytophthora ramorum*. For some years, this oomycete fungus has caused 'sudden oak death' in the western United States. In like manner, it now poses a serious threat to Japanese larch, and possibly other tree species, in Europe, and tanoak along 1,500 kilometres of forest in coastal California and Oregon<sup>33</sup> (Fig. 1). It is believed to have spread initially from a rhododendron nursery in the San Francisco Bay area and is now estimated to have killed several million trees. It exhibits the classic hallmarks of an invasive plant pathogen: genetic uniformity consistent with a genetic 'bottleneck', coupled with spread from multiple secondary foci<sup>34</sup>.

Damaging invasions of tree pathogens are not new, as earlier pandemics of Dutch elm disease and chestnut blight have shown. But these events seem to be accelerating owing to the combined effects of increasing globalization of trade in plants and a flow in international plant biosecurity protocols. Simply put, for trade purposes, organisms not yet described cannot be legislated against, yet infection resulting from human movement of infected plants<sup>4,5</sup>. *Phytophthora ramorum* is also the first major 'aerial' – as opposed to root infecting – forest *Phytophthora* species to be identified, attacking mainly foliage and stems, as does the potato blight, *Phytophthora infestans*. *Phytophthora ramorum* probably arrived in Europe in the 1990s, but was only for many years named as a new species in 2001 (ref. 6). Despite

many recent arrivals are completely new to science, presumably introduced from under-explored ecosystems<sup>1</sup>. Indeed some 90% of fungi are probably unknown, and therefore undescribed<sup>2</sup>. In Europe alone, aggressive invasive pathogens are currently spreading on pine, oak, alder, horse chestnut, ash and cypress, and many European riosides are infested with exotic fungal pathogens, especially species of *Phytophthora* ('plant destroyer')<sup>3</sup>.

A new species of unknown origin, *P. ramorum* has since 1995 afflicted evergreen oak

### Evaluation of eradication measures against *Anoplophora chinensis* in early stage infestations in Europe

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## Emerging Viral Diseases of Tomato Crops

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Field trials were conducted on plastic boxes artificially infested with an avirulent population of *Meloidogène janseni* to determine the durability of the resistance mediated by the Mg gene in tomato rootstocks after repeated cultivation for three consecutive years. Populations included an experimental rootstock cv. PG76 (Solanum lycopersicum × Solanum peruvianum) and a susceptible cv. Duetra (S. lycopersicum). Based on the reproduction index (RI) (number of eggs per g root or the number of rootstock divided by number of eggs per g root on the susceptible cultivar × 100), rootstock cv. PG76 responded to highly resistant (RI = 7%) after the first cropping cycle (34 nematode generations), showed intermediate resistance (RI = 33%) after the second cropping cycle (34 nematode generations) and was susceptible (RI = 41 and 25%, respectively) in contrast, rootstock cv. Brugos and resistant cv. Monika retained intermediate resistance levels (RI = 33 and 30%, respectively) after the third cropping cycle. Virulent nematode populations were rapidly selected from the susceptible cv. Duetra and the resistant cv. Monika after the first and second cropping cycles, respectively. These conditions confirmed that selection for virulence occurred more rapidly in plots with cv. PG76 followed by Brugos and Monika. The nematode population in the field not exposed to PG76 rootstock remained avirulent to Mg genotypes. The genetic background of the resistant rootstocks and the frequency of cropping were critical factors for the appearance of virulent nematode populations. Irrespective of nematode infection, all rootstock genotypes yielded more than the susceptible cultivar.

**Keywords:** durable resistance, nematode reproduction index, root-knot nematodes, *Solanum habrochaites*, virulence

Root-knot nematodes, *Meloidogyne* spp., are major pests of vegetable crops of intensive agriculture in several areas of the Mediterranean basin including Spain (Orrián *et al.*, 2001; Vindel-Lucas & Sorribes, 2008). Grafting vegetables is expanding in Europe and has been used alone or in combination with other control measures as a non-chemical alternative to soil fumigation, especially in the Mediterranean region (IMBOT, 2006). Within the Solanaceae, tomato (*Solanum lycopersicum*; formerly *Lycopersicon esculentum*), pepper and eggplant are the most successfully grafted crops. Most tomato rootstocks are interspecific hybrids of *S. lycopersicum* × *S. kalmianifolium* and they incorporate resistance to viruses, fungi and root-knot nematodes. The wild type *S. kalmianifolium* is

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primarily used to confer increased vigour to the root system of the grafted plants. These rootstocks improve nutrient absorption (Leonardi & Guiffreda, 2000), yield and fruit quality under various stress conditions (Fernández, 2002). Disease resistance in plants must be durable, that is, it should provide an efficient protection against the target organism during prolonged and widespread use in environments conducive to disease development (Johnston, 1999). In this context, the development of tomato rootstocks with *M. javanica* and *M. anomala* is threatened by the *M. incandescens* race (Roberts & Thornley, 1989) that was identified in the wild relative of tomato *S. peruvianum* and *S. pennellii* (Roberts & Thornley, 1989; Johnston, 1999; Smith, 1994). This gene has been the source of resistance to root-knot nematodes for more than 40 years in all resistant tomato cultivars worldwide, and may be considered as a very stable resistance gene in terms of its durability (Roberts & Thornley, 1989; Johnston, 1999; 2002). However, virulence, defined as the ability of the

lim head blight (FHB) of small grain cereals and ear rot in maize are significant diseases across the world, only result in reduced yield as a result of shrunken grains but also result in reduced milling and staling minimisation of grains with mycotoxins. Mycotoxins are hazardous to animal and human health. Therefore, diseases are in place, or under consideration, in most countries to protect consumers and animal welfare. *Aspergillus* are produced within the growing crop, it is important to understand how agricultural practices affect contamination of grain. Such information could then be used to determine guidelines on 'Good Agricultural Practice' as the mycotoxin contamination of cereal products. Evidence is provided to show the importance of choice of crop, soil cultivation, fertiliser and the chemical and biological control of insects, weeds and fungi. ILSI, published by Elsevier Ireland Ltd. All rights reserved.

<sup>1</sup> Fusarium ear blight; Wheat; Maize; Mycotoxins

FHB of wheat is predominantly caused

maize head blight (FHB) of small grain cereals and rice in maize are significant diseases across the world (Parry et al. 1995). In the US alone, the direct losses due to reduced yield and quality of FHB between 1991 and 1997 totalled more than \$3 billion (Johnson et al. 2003). More than 20 species have been associated with the diseases that predominate can vary depending on species involved, the region and the season (Parry et al. 1995). *Fusarium graminearum*, *F. culmorum*, *F. poae* and *Microdochium nivale* are the most common species that infect cereals can produce or mycotoxins. Many of the *Fusarium* species infect cereals produce trichothecene mycotoxins. These mycotoxins are divided, based on their structure, into A and type B trichothecenes. The most trichothecene found in cereals is deoxynivalenol (DON), which is a type B trichothecene produced predominantly by *Fusarium graminearum*.

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eral tissues are important limiting factors in many crop production systems. Additional genetic resources are needed to develop crop varieties that are tolerant to biotic stresses in general and to nematodes, in particular. This paper reports on the identification, characterization and use of plant materials containing nematode resistance genes in crop production systems. In addition, changing climate conditions and the impact of climate change on crop production and on the distribution and establishment of nematodes are discussed. The paper also discusses the use of nematode resistance genes in crop production systems and the impact of climate change on crop production and on the distribution and establishment of nematodes.

[illegible]

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and effectiveness of eradication measures in Europe has become available. The experiences from previous eradication actions can be very helpful to determine and optimize measures for any future outbreak. Therefore, this paper describes and evaluates the eradication actions in European countries against *A. chirodontae*. The paper focuses on the eradication actions in the Netherlands, a relatively early stage in Europe since 2003. No data are available for the infected area in Lombardy (Italy). In Lombardy, the pest was probably present for many years before it was detected in 2003. The pest appeared in the Netherlands in 2003, and in other municipalities after several years of monitoring (Mappeo *et al.* 2007). A detailed description of the situation in Lombardy will be presented in a forthcoming paper (B. Caviglia, Lombardy Plant Protection Service, pers. comm.).

Materials and methods

The eradication and control measures in the Netherlands have been extensively described in a recent review on *A. glauropilatus* and *A. chirodontae* (Black *et al.* 2005) and by Achadi (1996a). Anonymous (1997) and Langueval & Huelbe (2002). Aspects on the eradication and control measures in the Netherlands are discussed in more detail in the present paper.

**Synonymy:** *Anoplophora mukaii* (Thomson, 1965) is considered a synonym of *A. chinensis* (Forster 1771) (Lingafelter & Hoebeke, 2002; Haack *et al.*, 2010). Common name: Citrus longhorned beetle.

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European and Mediterranean Plant Protection Organization  
Organisation Européenne et Méditerranéenne pour la Protection des Plantes

Data sheets on quarantine pests  
Fiches informatives sur les organismes de quarantaine

*Rhynchophorus ferrugineus*

### Identity

**Name:** *Rhynchocephorus ferrugineus* (Olivier, 1790).  
**Synonyms:** *Calandra ferruginea* (Fabricius, 1801), *Cercuda ferrugineus* Olivier, 1790, *Rhynchophorus signatipilis* Chevrolat, 1882.

**Taxonomic position.** Insecta: Coleoptera: Curculionidae.  
Notes on taxonomy and nomenclature: the genus *Rhynchophorus* contains ten species, of which seven are known to attack pulpin (Bootti et al., 1990), including, besides *R. ferrugineus*, the EPPO A1 action list pest *Rhynchophorus palmatorum* (OEPPEPPO, 2005). A key was provided by Watanapensiri (1966). Reginald (1973) considers *R. ferrugineus* as the typical *Rhynchophorus* species. In Papua New Guinea, *R. ferrugineus* has been described as subsp.

1996, Comunidad Valenciana since 2004, Murcia, Islas Baleares and Islas Canarias since 2007), Turkey (since 2005, Murcia province).

**Asia:** Bahrain, Bangladesh, Cambodia, China (Guangdong), India (widespread), Indonesia (widespread), Iran, Iraq, Israel, Japan (since 2000, Kyushu only), Jordan (since 1999), Kuwait, Laos, Malaysia.

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### The spread of the western flower thrips *Frankliniella occidentalis* (Pergande)

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## Biology

Adults of *R.*, although flightless (Leefmans 1990), can find studies suggest of at least 900 males and females pre-oviposition confined to the approximately 1500 eggs on average trunk, as in the

or EPPOA2 action list no. 332.

pest of palms (*Arecaeae*), being  
in, *Arenga pinnata*, *Borassus*  
*ti*, *Caryota maxima*, *Caryota*  
*umbra* *phoenicea*, *Comodo* *slava*

## PEST RISK ANALYSIS

**Abstract** 1 Since the late 1970s, the western flower thrips has spread from its original distribution in western North America to become a major worldwide crop pest. 2 A wide range of data sources have been used to map the original distribution in the U.S.A. and Canada, and the progress of the spread in the U.S.A., Canada, Europe, northern Africa and Australia. 3 The possible reasons for the start of the spread are discussed. The most likely reason is that intensive insecticide use in horticulture in the 1970s and 1980s selected an insecticide resistant strain or strains. These then established in glasshouses across North America and spread from there to Europe, Asia, Africa and Australia.

The speed of spread was  $229 \pm 20$  km/year. It was faster in the open than in the glasshouses. The western flower thrips thrives in mild winters; for example, across the

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Review  
Structural change in the international horticultural industry: Some implications for plant health

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## Submitted Article

# The Impact of Preferential Trade Arrangements on EU Imports from Developing Countries: The Case of Fresh Cut Flowers

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**Abstract** This study examines the effects that the Generalized System of Preferences schemes for developing countries (GSP +) have on European Union (EU) demand for imported cut flowers. Without GSP +, a tariff would be applied to flowers from Colombia and Ecuador. Results show that Colombian carnation prices have a negative effect on EU flower expenditures, resulting in preferential treatment for Colombia being mostly trade-creating. When a tariff is applied to Colombia, imports of Colombian carnations and Kenyan roses fell by 7.3% and 1.9%, respectively, and other flowers from Ecuador and Israel fell by 1.9% and 1.8%, respectively. Total EU flower imports fell by 1.4%.

**Key words:** preferential trade, flowers, EU, Colombia, Ecuador, Kenya, Generalized System of Preferences.

**JEL codes:** Q17, Q18, F53.

***Tuta absoluta*, Tomato leaf miner moth or South American tomato moth**

# Discussion groups

## DG 4 – Climate change as driver of emerging plant health risks



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### Climate change and weed adaptation: can evolution of invasive plants lead to greater range expansion than forecasted?

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#### Summary

Invasive plants are frequently viewed as harbingers of climate change owing to their potential to cause economic and ecological damage in the process of expanding their ranges. Models are being developed to help predict the range expansion of these plants, based on known tolerance ranges. Success of weeds has often been attributed to an 'all-purpose genotype', implying a high level of phenotypic plasticity. However, recent work has shown that many species are capable of relatively rapid genetic change as well, enhancing their ability to invade new areas in response to anthropogenic ecosystem modification. We thus predict that range expansion by many invasive species will exceed that predicted by modelling approaches that do not consider potential evolutionary change. We highlight a number of

cases where weeds have expanded their latitudinal ranges or are predicted to do so in response to climate selection pressures. We also list ten traits as likely targets for natural selection under climate change. The first phase commonly observed for invasive species is frequently a result of the time needed for the invader to evolve to fit the new habitat. During this phase period of climate change, many invasive plant populations are likely to be in the process of developing



#### Host shifts in fungi caused by climate change?

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#### ABSTRACT

Understanding the factors that govern the occurrence and abundance of fungal species is critical to their conservation. Here, we show that the host range of a common species, *Aureobasidium antracnose-juncus*, has changed in the UK over the last 39 yr. Over this time, the species has shown altered phenology, with earlier appearance of fruit bodies and a longer fruiting period, consistent with a response to observed warming trends in climate. Coincident with the change in fruiting time is an expansion of its host range. We discuss how sampling artefacts are unlikely to be responsible for these changes and instead suggest that climate change has altered the competitive balance between fungal species that inhabit dead wood. Changing temperature and rainfall regimes cause different germination rates, growth rates and competitive ability of one species relative to another, and in the case of *A. antracnose-juncus* may have resulted in the ability to colonise a wider host range. Thus, fungal host range must be thought of as a dynamic concept when formulating conservation strategies.

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Forest Ecology  
and  
Management

### Climate, soils and *Cephalcia arvensis* outbreaks on *Picea abies* in the Italian Alps<sup>1</sup>

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#### Abstract

The recent outbreaks (1986–1992) of the spruce web-spinning sawfly *Cephalcia arvensis* (Dufour) (Hymenoptera: Pamphiliidae) extended over 1500 ha of spruce (*Picea abies* Karst.) stands in the Italian Alps (north-east Italy). Among the possible causes of these outbreaks, the effect of climate change was investigated. The data to be considered are: (1) the period 1983–1986 showed a hot and dry climate; (2) the period 1987–1992 showed a cold and wet climate; (3) the period 1993–1996 showed a hot and dry climate; (4) the period 1997–2004 showed a cold and wet climate. The relationships between climate and attack levels could be: (1) lower mortality and faster development of the insect induced by high temperatures and lack of precipitation; (2) increase of food quality as a result of the trees, according to the soil and stand characteristics.

**Keywords:** Sawfly; Defoliation; Pine; Water stress

### EXPANSION OF GEOGRAPHIC RANGE IN THE PINE PROCESSIONARY MOTH CAUSED BY INCREASED WINTER TEMPERATURES

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**Abstract.** Global warming is predicted to cause distributional changes in organisms whose geographic ranges are controlled by temperature. We report a recent latitudinal and altitudinal expansion of the pine processionary moth, *Thaumetopoea pityocampa*, whose larvae build silk nests and feed on pine foliage in the winter. In north-central France (Paris Basin), its range boundary has shifted by 85 km northwards between 1972 and 2004; in northern Italy (Alps), an altitudinal shift of 110–230 m upwards occurred between 1975 and 2004. By experimentally linking winter temperature, feeding activity, and survival of *T. pityocampa* larvae, we attribute the expansion to increased winter survival due to a warming trend over the past three decades. In the laboratory we determined the minimum nest and night air temperatures required for larval feeding and developed a mechanistic model based on these temperature thresholds. We tested the model in a translocation experiment that employed natural temperature gradients as spatial analogues for global warming. In all transects we transferred colonies of *T. pityocampa* larvae to sites within zones of historical distribution, recent distribution, and outside the present range. We monitored air and nest temperature, incoming solar radiation, larval phenology, feeding activity, and survival. Early-season temperature effects on phenology were evident, with delayed development of colonies in the more extreme (colder) sites. In the coldest months, our model was consistent with the observed patterns of feeding activity. Feeding was progressively reduced with increasing latitude or elevation, as predicted by the lower number of hours when the feeding threshold was reached, which negatively affected final survival. Isolation raised nest temperature and increased feeding activity on the south but not the north aspect. Prolonged temperature drops below the feeding thresholds occurred at all sites, leading to starvation and partial mortality. Nonetheless, even the most extreme sites still allowed some feeding and, consequently, up to 20% colony survival and successful pupation. Given that the present distribution of the oligophagous *T. pityocampa* is not constrained by the distribution of its actual or potential hosts, and that warmer winters will cause the number of hours of feeding to increase and the probability of the lower lethal temperature to decrease, we expect the trend of improved survival in previously prohibitive environments to continue, causing further latitudinal and altitudinal expansion. This work highlights the need to develop temperature-based predictive models for future range shifts of winter-limited species, with potential applications in management.

**Key words:** climate change; feeding activity; insect pest; larval survival; Lepidoptera; Pine; range expansion; spatial dynamics; *Thaumetopoea pityocampa*.

### IMPLICATIONS OF ATMOSPHERIC CO<sub>2</sub> ENRICHMENT AND CLIMATIC CHANGE FOR THE GEOGRAPHICAL DISTRIBUTION OF TWO INTRODUCED VINES IN THE U.S.A.\*

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**Abstract.** The continuing increase in the atmospheric carbon dioxide concentration resulting from fossil fuel combustion and deforestation may change the ecological impact and geographical distribution of kudzu (*Pueraria lobata* Ohwi) and Japanese honeysuckle (*Lonicera japonica* Thunb.) in the U.S.A. Both vines were introduced about a century ago from Japan and have become naturalized weeds. Westward range expansion is currently limited by drought during seedling establishment, while northward range expansion is limited by low temperature sensitivity of overwintering stems.

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### The nexus of host and pathogen phenology: understanding the disease triangle with climate change

We have observed a remarkable increase in large-scale, sudden onset of decline (unknown cause) and known disease (bacterial, fungal, viral) outbreaks in the last few decades, with more predicted globally (Carter et al., 2009). Increases in temperature, changes in the timing and effectiveness of precipitation, the change in the frequency and intensity of other, catastrophic events (e.g. wildfires, tornadoes, bush fires, hurricanes) and invasions of both native and exotic pathogens have driven unlikely combinations of host plants, plant pathogens and environmental variability together with unprecedented outcomes. A recent outbreak in *Alnus incana* in western Alaska, associated with the heat, dry summer of 2004 (Bunn et al., 2009), has refocused attention on the role of temperature and drought in sudden decline (Schwartz, 1975). In this issue of *New Phytologist*, Robert Baskin et al. (pp. 295–307) open a new line of research in host–pathogen relationships with their experimental test of the interaction of the phenology of host susceptibility (*Alnus fraterna*), the life cycle of the pathogen (*Valsa microsticta*) and environmental variability (temperature, drought).

**Each discussion group** will address the following issues:

- How do we recognise these changes?
- How can we anticipate these changes? Is prediction possible?
- What are the implications of these changes for managing risk?
- Can we learn from the past? Are there any case studies for retrospective analysis?

The outcome of the four DGs will be presented and discussed in a **final plenary session**:

- To discuss in the plenary session the results of each discussion group
- To integrate the four different scales of the discussions and to formulate conclusions and, as appropriate, recommendations.

Thank you for your attention