Plant diseases – a herald of environmental changes

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Environmental changes (climate change, world evolution, human affected) can alter morphology and physiology of plants, and geographic distribution of both wild and cultural species. All these modifications reflect in plant-associated microflora and development of plant pathogens as well. Climate warming causes a pole-ward shift not only different plants but also their pathogens. So identification of plant pathogen fungi for the first time could be as the signal of environmental changes (Garrett *et al.*, 2006). There are many reports that geographical ranges of many plant diseases alter also in Europe. The diseases, mentioned quite often, are different powdery mildews and rusts as well (Desprez-Loustau *et al.*, 2007; Glawe, 2008). The objective is to present some observations and findings in regard to plant pathogens identification in Latvia.

Materials and Methods

During some last summers several collections of rhododendrons (*Rhododendrons*) had been inspected in the different regions of Latvia (Fig. 1) to evaluate the spread of the powdery mildew symptoms as well as to characterize and identify the pathogen. In the may 2009, symptoms of rust were observed on snowdrops (*Galanthus plicatus*) in the Botanical Garden of University of Latvia in Riga. Identification of the specimens was carried-out by microscopic observation of the morphological characteristic of fungi.

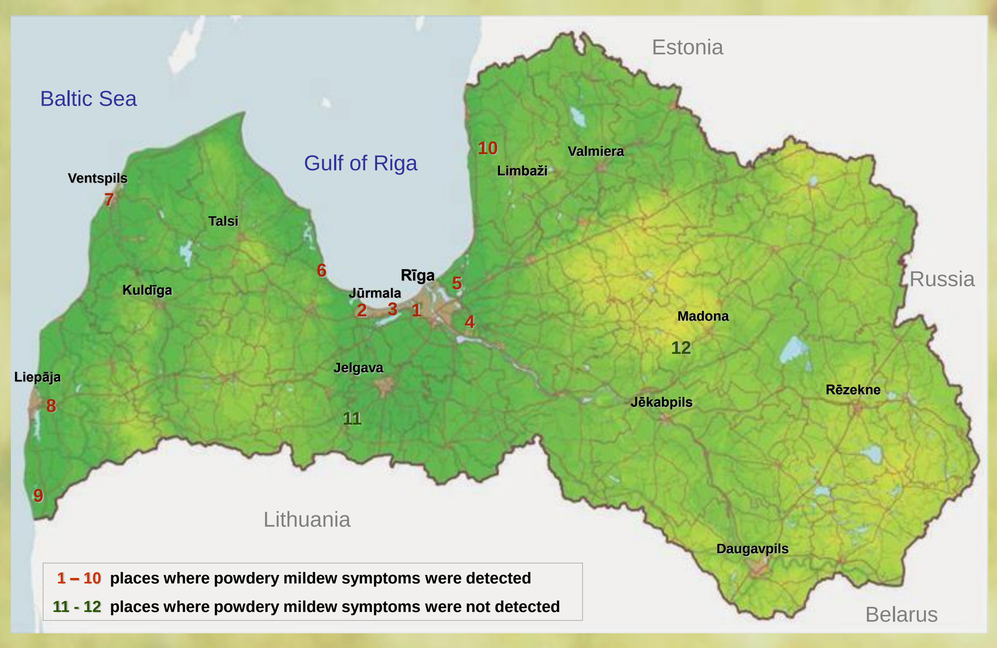

Fig. 1 Rhododendron's collections examined for presence of powdery mildew symptoms:

1. several public parks and gardens in Riga (Botanic Garden of the University of Latvia, Opera garden etc.),
2. several public parks and gardens in Jūrmala (Bulduri Horticulture School garden, Rhododendron nursery at Dubulti etc.),
3. Experimental and Breeding Nursery of Rhododendrons "Babīte" of the University of Latvia,
4. National Botanical Garden of Latvia at Salaspils,
5. Tree nursery „Baltezers",
6. Dendrarium „Lāčupīte",
7. several public parks in Ventspils,
8. Private botanic garden of I. Graudiņš,
9. Rucava Arboretum,
10. private rhododendron collection near Viļķene,
11. Tree nursery „Zaļenieki",
12. Kalsanava Arboretum.

Fig. 2 Powdery mildew on rhododendrons:
A - contaminated shrub of deciduous rhododendron;
B - chasmothecia on lower side of leaf.

Results

Observations of powdery mildew symptoms distribution indicated that so far infected rhododendrons had been detected in the collections located in Riga and near to it (Fig. 1), as well as in the whole region southwest from Riga. But last year the powdery mildew was found in one collection located in the northern direction from Riga for the first time (Fig. 1, point 10).
Powdery mildew symptoms were observed on many species and cultivars of deciduous and evergreen rhododendrons (Fig. 2A). The fungus affected upper and lower surfaces of leaves as well as seed pods. By the end of August a great number of dark brown chasmothecia (Fig. 2B). These anatomical-morphological features indicated that the pathogen belongs to order *Erysiphales*.
In May 2009, snowdrops (*G. plicatus*) showing symptoms of rust were found in the Botanical Garden of University of Latvia (Fig. 1A). Symptoms were small orange pustules (aecia) on both sides of leaves (Fig. 1B). The aecial state of this rust under light microscopy had the morphology of *Melampsora allii-fragilis* f. sp. *galanthi-fragilis* (Bagyanarayana, 2005).

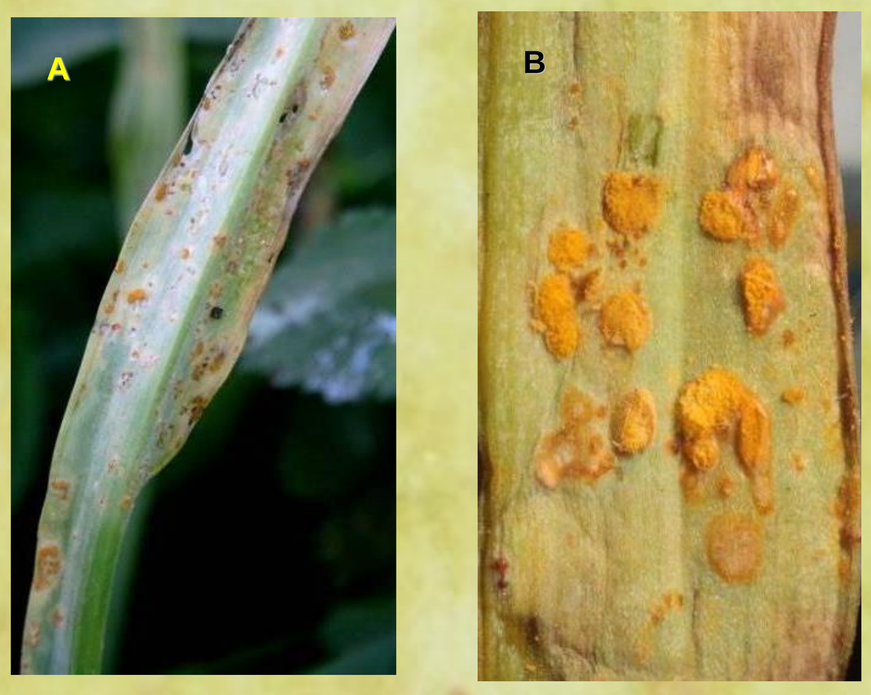

Fig. 3 Rust lesions on *Galanthus plicatus*:
A – infected leaf; B – pustules on the leaf surface.

Discussion

Fungi of order *Erysiphales* caused powdery mildew on rhododendrons are native pathogen in North America, Asia and Australia (Farr et al., 1996). In Europe powdery mildew on Rhododendrons has become one of the most serious diseases only for the last 20 years (Inman et al., 2000). Since nineties it has been observed in many states of Europe: UK, Germany, Poland, Czech Republic, Lithuania etc. Since 2006 symptoms of powdery mildew were detected on rhododendrons in Latvia. The first serious outbreaks of disease were observed in Riga and near to it (Fig. 1) - in the places where the largest amount of the rhododendrons was located in Latvia.
Powdery mildew is called "the disease of climate change" because it spread is promoted by increase of temperature. Numerous reports show that pathogen fungi causing powdery mildews increase their spatial area northward (Glawe, 2008). For example, in summer 2007 powdery mildew of strawberries, was detected under open field conditions for the first time in Latvia (Jarmoliča, Bankina, 2009). Earlier the distribution area of rust fungus *M. allii-fragilis* Kleb. f. sp. *galanthi-fragilis* (Kleb.) included only region central Europe that is located more southern than Latvia: in France, Austria, Czech Republic, Poland, Romania (Bagyanarayana, 2005) etc.
So it is obviously that plant disease development is the summary result of various factors and it depends on complex interaction between plant host, pathogen and environmental conditions. Environmental conditions can include not only global climate changes but also increasing plant trade, introduction of numerous new plant taxa etc. (Garrett *et al.*, 2006). For example: rhododendrons became popular during last 50 years in Latvia: new sorts are introduced and intensive trade is going on.
In the future we can expect that plant pathogens will continue to shift their distribution area and follow their hosts further north and it will be results of both natural and human affected processes. Botanical gardens have large-scale plant collections, long-term phonological records and knowledgeable staff. It is the reason why botanical gardens should contribute studies to help to understand relationships among environmental changes, plants and their associated microflora as well as to identify pathogens, biosecurity risks and management strategies for plant diseases emerging as a result of climate change (Primack, Miller-Rushing, 2009).

Acknowledgments

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