

PROCEEDINGS OF THE INTERNATIONAL ONE-DAY SEMINAR “WHAT DOES THE FUTURE HOLD FOR BOXWOOD?”

HELD ON 4 MARCH 2015 AND ORGANISED BY THE DOMAINE DE VAUX-LE-VICOMTE IN
PARTNERSHIP WITH PLANTE & CITÉ



Almost 200 people attended the international one-day seminar held on 4 March at Vaux-le-Vicomte

Proceedings taken by Plante & Cité during the international one-day seminar organised by the Vaux-le-Vicomte Estate / Authors: Maxime Guérin & Caroline Gutleben – Plante & Cité

INTRODUCTION

Boxwood has been one of the hallmarks of the beauty and grandeur of historic gardens for centuries. However, since the 2000s it has been gradually dying, largely as a result of dieback diseases and the box tree moth. Many countries have been affected, including the UK, the Netherlands, Belgium and the United States, and now it is France's turn. After the damage caused in autumn 2013 and throughout the summer of 2014, it is clear that the situation needs to be addressed as a matter of urgency.

Information on these diseases and pests, how to recognise them and potential management solutions is not readily available. We therefore felt it necessary and even urgent to organise a seminar on these issues to assess:

- the current situation regarding the spread of disease and the box tree moth
- progress of research in France and abroad with the SaveBuxus project
- possible ways to combat the situation
- solutions for replacing boxwood.

This one-day seminar entitled “What does the future hold for boxwood?” took place at Château de Vaux-le-Vicomte, 35 miles south-east of Paris, on 4 March 2015 and brought together Europe's top specialists. The large audience (almost 200 people) was made up exclusively of “garden professionals” – garden owners and managers, local authorities, scientists, landscapers and head gardeners. You will find below the full proceedings of the seminar in the form of a transcript of the presentations and audience and panel session discussions.

We hope you will enjoy reading it.

Caroline Gutleben

Plante et Cité

Alexandre de Vogüé

Château de Vaux-le-Vicomte

SEMINAR PARTNERS

Château de Vaux-le-Vicomte thanks its two official partners for their help in organising the “What does the future hold for boxwood?” one-day seminar: “Les Gazons de France” and “SNA Europe France” through its BAHCO brand.



La Fondation des Parcs et Jardins de France (FPJF) also provided support for this event.



CONTENTS

A - SEMINAR PARTNERS / PAGE 3

B - ASSESSMENT OF THE SITUATION AND RESEARCH OVERVIEW / PAGE 5

CAROLINE GUTLEBEN, PLANTE & CITE

C – CASE STUDIES / PAGE 7

1. MURIEL DE CUREL, OWNER OF THE SAINT JEAN DE BEAUREGARD CHATEAU AND VEGETABLE GARDEN / PAGE 7
2. LUCIE LE CHAUDELEC, HEAD OF THE PLANT STUDY DIVISION, CITY OF PARIS / PAGE 8
3. CHRIS CROWDER, HEAD GARDENER AT LEVENS HALL, UK (MORNING, AFTERNOON) / PAGE 10

D - RESEARCH INTO THE CONTROL OF BOXWOOD PESTS AND DISEASES/ PAGE 12

1. SESSION 1: BOXWOOD DIEBACK DISEASES
KURT HEUNGENS, ILVO / PAGE 12
2. SESSION 2: THE BOX TREE MOTH
 - a. MARC KENIS, CABI / PAGE 14
 - b. JEAN-CLAUDE MARTIN, INRA / PAGE 16

E - PANEL SESSION: “CARING FOR OUR GARDENS IN THE FUTURE” / PAGE 18

1. DISCUSSION SUMMARY / PAGE 18
2. QUESTION & ANSWER SESSION / PAGE 22

F - LIST OF LABORATORIES THAT OFFER PHYTOSANITARY ANALYSES FOR BOXWOOD (MEMBERS OF THE FRENCH PLANT PROTECTION NETWORK) / PAGE 25

ASSESSMENT OF THE SITUATION AND RESEARCH OVERVIEW

CAROLINE GUTLEBEN, PLANTE & CITE

About the speaker and her organisation

Caroline Gutleben is director of Plante & Cité, a French national technical centre dedicated to landscape and urban horticulture. Plante & Cité was founded in 2005 at the initiative of local authorities, landscape companies and urban vegetation research organisations to act as an interface between the world of business and world of scientific research. Every year Plante & Cité coordinates some thirty studies and trials, one of which is the SaveBuxus® programme with the Astredhor technical horticultural institute.



Aim of the session. The presentation provides an overview of the phytosanitary problems affecting boxwood and the research being conducted in France and internationally on boxwood's main pests and diseases.

Session content

To set the scene, boxwood is a familiar plant that is present in many public parks where it adds structure. Its architectural and physiological properties make it ideal for creating the spectacular shapes that have become the art form known as topiary and boxwood sculpture. For centuries boxwood has been the signature art of French formal gardens but it is also found in the wild, where it forms the understorey of many forests in the north-east and south-west of France. All of these landscapes can potentially be undermined by the current phytosanitary issues, hence the concern and efforts being made to find solutions.

In terms of pests, many species occur on boxwood: the mealybug (*Pseudococcus sp.*), the box leaf miner (*Monathropalpus buxi*), the box psyllid (*Psylla buxi*) and the red spider mite (*Tetranychus urticae*). But none has the impact of the box tree moth (*Cydalima perspectalis*), which causes severe defoliation. Native to Asia, the box tree moth has spread rapidly throughout Europe since its arrival in 2006–2007. In France, its spread is advancing every year and by the end of 2014, more than 70 regional departments were affected.

With regard to pathogens, these, too, pose many problems: leaf dieback related to *Volutella buxi*, root and collar rot related to *Phytophthora cinnamomi*, boxwood rust (*Puccinia buxi*), boxwood fungus (*Fusarium buxicola*) and, most serious of all, boxwood blight (*Cylindrocladium buxicola*). France's forest health department started reporting dieback in forest environments in 2008 while the Plant Health Bulletins, prepared by France's regional federations for protection against harmful organisms (FREDON), have been reporting significant dieback in parks and gardens since 2006.

As regards the situation in France, completely eradicating these pests and diseases is not feasible since their presence throughout the country is too extensive. Equally, limiting their spread is also difficult to envisage. On the other hand, action can be taken to curb dispersal, limit damage, protect boxwood and safeguard the heritage of our gardens.

International research on the box tree moth is focusing on several areas:

- The biology and ecology of the moth: e.g. colonisation and dispersal methods, life cycle, number of generations, hosts and varietal preferences.
- Methods and tools for detecting pests and monitoring boxwood: e.g. monitoring via the use of sex pheromones, plant observation methods.
- Egg-stage pest control: e.g. biological pest control using native and non-native egg parasitoids.

- Larval-stage pest control: e.g. conventional insecticides, entomopathogenic bacteria and nematodes, entomopathogenic viruses and fungi, mechanical solutions, application techniques.
- Adult-stage pest control: e.g. pheromone mass trapping, mating disruption.

International research on boxwood blight is focusing on the following areas:

- Biology and genetics: e.g. phylogeny, conditions for development and infection.
- Diagnostic tools: e.g. epidemiological model to predict development of the fungus, symptomatology, molecular detection.
- Methods for preventative management and prophylaxis: e.g. preventative fungicides, plant strengtheners, cultivation methods that limit development of the fungus, pruning tool disinfectants, varietal tolerance, genetic selection.
- Solutions for treating aerial parts: fungicides including biocontrol products and biostimulants.
- Solutions for treating soil that can harbour fungal spores: e.g. fungicides including biocontrol products, biostimulants, soil disinfectants.

In France, the national research and experimentation programme SaveBuxus® is working to identify and evaluate the effectiveness of biocontrol solutions in combating the box tree moth and dieback diseases. The goal is to develop strategies for managing landscapes, gardens and the boxwood production sector by 2017. The programme is being coordinated by Plante & Cité and the Astredhor technical institute in conjunction with the French National Institute for Agricultural Research (INRA) and biocontrol specialist Koppert. SaveBuxus® is currently being funded by the French National Agency for Water and Aquatic Environments (Onema) under France's Ecophyto Plan, the French horticultural association Val'hor, FranceAgriMer, and Fondation de France. Initial results will be published on the Plante & Cité website at www.plante-et-cite.fr.

Technical and scientific programme partners:

ASTREDHOR: the Arexhor Seine-Manche experimental stations; the Fleurs et Plantes du Sud-Ouest EIG; Arexhor Grand Est; the Val-de-Loire horticultural development committee; Caté
INRA: Mediterranean forest entomology research unit in the southern Provence-Alpes-Côte d'Azur region.
Koppert: biological crop protection specialists

Plante&Cité
Ingénierie de la nature **en ville**



ASTREDHOR
Institut technique de l'horticulture



KOPPERT
BIOLOGICAL SYSTEMS

Financial partners:



CASE STUDIES

MURIEL DE CUREL, OWNER OF THE SAINT JEAN DE BEAUREGARD CHATEAU AND VEGETABLE GARDEN

About the speaker and her organisation

Muriel de Curel is owner of the Saint Jean de Beauregard estate, listed as one of France's "Remarkable Gardens" and famous for its spring plant fair. Created in 1610, the Saint-Jean de Beauregard vegetable garden is open to the public and is a French national heritage site.



Domaine de Saint-Jean de Beauregard©

The boxwood. The garden has 2000 metres of boxwood edging which represents a significant part of its framework. Trimmed boxwood can be found in the vegetable garden, the formal gardens and in latticing, while free-growing boxwood is found in the park and woods.

Health of the boxwood. In April 2013, boxwood in poor condition was reported in the garden. Almost all the boxwood was affected to a greater or lesser degree. The worst affected boxwood was located in the moistest areas. Boxwood shaded by other plants or untrimmed boxwood in woods was less affected. Determining the cause of this large-scale dieback proved difficult.

The team initially thought it was a management issue (lack of water or nutrients, for example), but then realised that it was in fact a phytosanitary issue. The boxwood was therefore treated with a tetraconazole-based fungicide but this had no effect. The garden called in the French plant clinic FREDON Centre to help identify the cause. What was initially believed to be a thrips attack turned out to be dieback disease.

Depending on their location, some boxwood plants were attacked, while others remained in perfect health. Planting conditions and microclimate seemed to play a role in whether or not the disease took hold. Today, no effective management solution has been found (neither fungicide nor manure-based treatments). This is having a dramatic impact on the garden, both historically and aesthetically.

LUCIE LE CHAUDELEC, HEAD OF THE PLANT STUDY DIVISION, CITY OF PARIS

About the speaker and her organisation

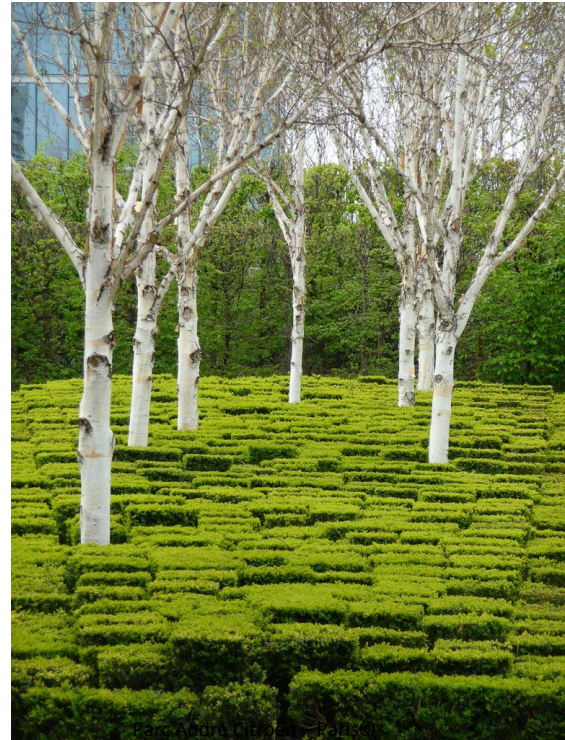
Lucie le Cuadelec is head of the plant study division in the City of Paris's parks and environmental department. The department is in charge of 3000 ha of parks and the division sets up testing to support management operations.

The boxwood. Paris's parks and gardens contain 10km of boxwood edging, 8km of boxwood hedges and 1800 boxwood topiaries (especially in the Jardin des Métamorphoses). There are several species of boxwood involved.

Health of the boxwood. The City of Paris has been dealing with the problem of the box tree moth for a number of years. The moth was first discovered in the Parc de Bagatelle and Père Lachaise cemetery in 2010. After that, a team of observers was set up to identify new hosts and report locally.

A number of methods were tested in an effort to control this pest in compliance with France's goal of "zero pesticides" (*Objectif zéro phyto*):

- Mechanical methods: manual bush cleaning (extremely time-consuming), water blasting (rejected because it induced other kinds of problem) and, as a last resort, uprooting.
- Biological methods: *Bacillus thurengiensis*-based treatment, problematic because it requires 24 to 48 hours between treatments for certain species, and Spinosad®. However, these are classified products and therefore not compatible with the Ecojardin® label of ecologically managed parks and gardens (cf. www.ecojardin.fr).



Procedural guidelines for gardeners were drawn up. Based on the role of the boxwood (structural or non-structural), it was decided either to uproot it and replace it with something else, or keep it and try to control the box tree moth. Boxwood was uprooted on a case-by-case basis. In 2014, 110m³ of boxwood was removed via seven collection points.

Trials were carried out using alternatives. In the Bercy Park, for example, boxwood was replaced with veronicas, germanders and cotoneasters, while hornbeams (which unfortunately are allergenic) and osmanthus were used for hedges. Gardeners who are particularly attached to boxwood are not always accepting of this practice, and the trials were not very satisfactory, especially from an aesthetic viewpoint.

An information campaign on the box tree moth was also launched, targeting gardening workshop representatives (via a health watch programme run by Jean-Emmanuel Michaut) as well as Parisians (via a blog produced by the Paris parks and environment department, DEVE).

In addition, to help with the research effort, DEVE is participating in the national SaveBuxus® programme, monitoring the flights of box tree moths over three of these parks (Musée Carnavalet, Parc Floral and Père Lachaise).

Solutions are now in place and it may be possible to manage certain situations but additional work is needed before coming up with a holistic strategy to combat the box tree moth. But one of the main difficulties is the fact that people with private gardens or other boxwood owners within the city either do not manage the moth's host or do so poorly.

Open-floor discussion



In answer to a question from Mr Chausson, it was specified that pruning was one of the management methods tested but more experimenting is needed before conclusions can be drawn as to whether this method is worthwhile. It tends to be used at the beginning of the season.

One person asked whether Paris had encountered any issues with architects belonging to France's architectural heritage association, (*architectes des bâtiments de France*) when the boxwood was uprooted. Unfortunately their reaction time is too long given the quick response required to manage this issue.

Questions were also asked about the burden of regulations on management practices. The City of Paris does not challenge the "zero pesticide" practices or the Ecojardin label. Despite the difficulties currently being encountered with the box tree moth, there is no turning back.

Following a comment from Odile Audebert, who said that *Buxus rotundifolia* were more resistant, it was specified that attacks on this species had been reported in Paris. Patrick Borgeot pointed out that *B. rotundifolia* were nevertheless more tolerant to disease in general. Caroline Gutleben said that a lot of research was being carried out on the susceptibility of different species.

In answer to a question from Maxime Guérin, it was specified that cafés whose terraces are often decorated with potted boxwood had been informed about the problem of the box tree moth via the City of Paris website.

About the speaker and his organisation

Chris Crowder has been head gardener at Levens Hall, the world's largest topiary garden, for 30 years.

He runs the garden in the spirit of its creator, French gardener Guillaume de Beaumont.

The boxwood. The garden contains over 100 pieces up to 10m tall, plus 2km of boxwood edging. Some sculptures are more than 300 years old. Trimming the hedges takes many months each year.



Levens Hall, England – North News and Picture Ltd©

Health of the boxwood.

The first defoliations were reported in 2009. They can occur very quickly in warm, moist conditions. The damage was caused by boxwood blight. *Buxus suffruticosa*, used in boxwood edging, was the most susceptible.

A variety of pest control methods were tested, including fungicide treatments (one treatment every 10 days, which was very onerous), seaweed-based products, trimming infected branches, uprooting and burning. None was satisfactory and these methods need to be used in combination if they are to show any effectiveness.

In 2012 a major replanting project was implemented, starting afresh just six weeks before the garden was due to open to the public. Two kilometres of hedging had to be replaced. A number of solutions were tested:

- Grass aisles and herbaceous borders to give the garden structure.
- Removal of non-perennial wicker trellising.
- Flowering plants: lavender (ill-suited to so much moisture), sage.
- Germander (*Teucrium x lucidrys*), which produced good results, is melliferous and is now being used in the garden.
- Cotoneasters, barberry (stinging), holly, although none proved entirely satisfactory. In particular, *Ilex crenata*, or Dark Green holly, was planted after it was discovered during a visit to the Netherlands. But there were problems with its irregular growth (long shoots that required trimming at least twice a year), yellowing foliage, lesser durability compared with boxwood (it has to be replaced approximately every 15 years versus every 50 years for boxwood), fertilisation needs and susceptibility to acidic soils and frost. However, it is currently one of the best alternatives.
- *Lonicera nitida* or yew, which develops other types of disease.

In 2014, there was no boxwood blight reported in the garden. Was this due to climate conditions? Changes in practices in the garden? The use of phytosanitary products? It is still too early to tell.

Given the lack of effective solutions, perhaps the best response is to accept the problem and try to tackle it by substitution and replacement based on each context and each garden. After all, gardens are in a constant state of evolution! The changes made do not seem to have had any impact on visitors. In fact, they didn't even notice them. Chris Crowder nevertheless hopes that the new varieties of boxwood that are tolerant or resistant to disease will allow the plant to be reintroduced to the same extent as in the

past, since boxwood is after all irreplaceable. We need to continue to discuss the issue so that everyone can share their practices.

Open-floor discussion

A representative from Arbutus said that *Lonicera* deteriorates faster than *Ilex*. *Lonicera* was also tested at Levens Hall. Chris Crowder expressed surprised at the problems encountered and said that it would probably take three years for the shrubs to show their potential. However, grower Alexandre de Vogüé said that the large amount of trimming required was not feasible from a financial standpoint. He recommended trimming twice a year. He also said that the Dark Green variety was just one solution of many that needs to be adapted to context and situation.

RESEARCH INTO THE CONTROL OF BOXWOOD PESTS AND DISEASES

SESSION 1: BOXWOOD DIEBACK DISEASES

KURT HEUNGENS, ILVO

About the speaker and his organisation

Kurt Heungens is a plant pathologist and researcher at ILVO, the Belgian Institute for Agriculture and Fisheries Research. He is based in Merelbeke in Flanders.

Aim of the session. The presentation discussed diagnosing dieback diseases, including boxwood blight (*Cylindrocladium*) and the pathogens that cause it, and the results of international research on control methods, such as cultivation practices, fungicides, tolerance and varietal resistance.

Session content

Early diagnosis of *Cylindrocladium* (boxwood blight) is crucial if the infestation is to be contained, particularly when climate conditions are favourable to the pathogen's development (periods of rain or moisture and temperatures above 12–15°C). Unfortunately, symptoms often do not tend to be noticed until the final development stage when the disease is already widespread and leaves have started to drop.

The first symptoms to look for are brown to black lesions, often with a clear centre that quickly increases in size. The most typical symptoms are black lesions on stems and branches.

The *Volutella* fungus is responsible for secondary infections. Its development is linked to the presence of pruning wounds, frost-related damage or stress related to fungicide overdose. Symptoms of *Volutella buxi* (clusters of pink spores, lack of longitudinal lesions on branches) differ from those of boxwood blight.

The causal agent of boxwood blight is a fungus from the *Calonectria* genus (the name stabilised after initially being designated as *Cylindrocladium*) that can be divided into two clades: G1 (*Calonectria pseudonaviculata*) and G2 (*Calonectria henricotiae*, currently under submission). These two clades differ in terms of their tolerance to heat (G2 withstands high temperatures better than G1) and fungicide susceptibility (G2 is less susceptible than G1 to a series of fungicides). On the other hand, the two clades appear to have the same pathogenicity on 40 or so cultivars. Little is known about their origin. While G1 has been present in many European countries since the 1990s, G2 was first reported in 2005 and is seen less frequently and only in a few countries.

The virulence of boxwood blight and the challenges of safeguarding boxwood mean that research is or has been very active, especially in the United States and Europe (Belgium, the Netherlands, Germany and the UK).

Several avenues for controlling boxwood blight are being pursued:

- **Cultivation methods**

The cultivation method principle entails knowing the conditions under which the pathogen can develop and how it is affected by cultivation practices (planting, irrigation, fertilisation, pruning, and so on). Research has revealed in particular that young leaves become infected at lower temperatures than mature leaves. Rain or spray irrigation are the main causes of fungal spore dispersal, with wind



Dieback related to *Cylindrocladium* sp. / Station
Arexhor Seine-Manche – Plante & Cité©

playing only a minor role. Spores are also disseminated by pruning equipment, especially in moist conditions, albeit to a lesser degree. Pruning wounds generate an additional risk of contamination. Box blight spores survive in infected leaves and lesions on stems and branches. Spores can survive several years in dead leaves in litterfall.

- **Control via fungicides**

Many experiments have been conducted to assess the effectiveness of fungicides as a preventive and curative treatment. Products tested by ILVO in Belgium and which appear to be effective are not all approved for use in France. They must be applied with sufficient quantities of mulch and phytotoxicity risks must be monitored in the case of repeated treatments with high concentrations. Preventative treatments should only be carried out for cases of high phytosanitary risk (moist foliage, rain, mild temperatures) and on the most susceptible cultivars. This can mean up to six applications per year. Differences in effectiveness were reported between the two boxwood blight clades, G1 and G2, over a series of fungicides.

- **Varietal tolerance/resistance**

Work has been conducted in Belgium and the United States to assess the susceptibility of different boxwood species and cultivars. While susceptibility varies widely, there does not appear to be any truly resistant boxwood. That said, genetic variations among boxwood species raise the possibility of being able to select more tolerant cultivars.

Tolerance also seems to have an effect on the general health of boxwood and the kind of fertilisation required. Some experts recommend reducing the amount of nitrogen fertilisation but experiments to verify the effects of this are not always possible.

To conclude his presentation, Kurt Heungens offered some general ideas:

- For new plantings:
 - Use the least susceptible cultivars
 - Wait until new resistant varieties are available on the market
 - Use alternatives to boxwood, even if those plants have problems of their own.
- For existing plantings:
 - If the disease is not present, prevent its introduction through cultivation strategies and plant-health monitoring.
 - If the disease is present, implement a strategy that combines fungicide applications and cultivation techniques.

Open-floor discussion

Jérôme Jullien said that although *Cylindrocladium* and the *Volutella* fungus can be confused, their symptoms differ. In the case of *Volutella*, there is no black necrosis on stems and branches. At the request of Eric Chapin (from consulting firm COSAVE), Kurt Heungens explained that ILVO had developed a kit for determining the strain of *cylindrocladium* (G1 or G2) based on temperature thresholds. He is ready to send this kit and the methodology to diagnostic laboratories in France. Patrick Mioulane asked how much time should be allowed between uprooting and replanting the boxwood. Kurt Heungens suggested not replanting with the same cultivar. It is also advisable to change the planting soil since it may contain boxwood blight spores.

RESEARCH INTO THE CONTROL OF BOXWOOD PESTS AND DISEASES

SESSION 2: THE BOX TREE MOTH

MARC KENIS, CABI

About the speaker and his organisation

Marc Kenis is a researcher at CABI, an international applied research and scientific expertise organisation that focuses on agriculture and the environment. He is based in Delémont, Switzerland.

Aim of the session. The presentation focused on the origin and invasion of the box tree moth in Europe, current knowledge of its biology and the outlook for long-term control.



Damage caused by the box tree moth in a Swiss forest – CABI ©

Session content

First of all, boxwood is an ornamental plant (*Buxus sempervirens*, *B. microphylla* and many cultivars), but it also grows in the wild (*B. sempervirens*, *B. balearica*) in many parts of Europe. Boxwood faced very few natural threats before the arrival in Europe of the box tree moth and the development of dieback diseases.

The box tree moth is native to an area extending across China, Korea and Japan to the borders of Russia and India. In 2007 the moth was reported in Weil am Rhein (Germany) and subsequently in Basel (Switzerland) and the Netherlands. Its arrival is linked to global trade. According to reports, more than one million boxwood plants are imported each year, mostly to the Netherlands from China (2010 data). Central Europe was the first region to be affected, followed by neighbouring countries to the east (Romania and Turkey as well as Sochi in Russia) and western Europe (UK, France and Spain).

With regard to the moth's biology, two generations per year have been recorded in northern and central France and in Switzerland, while up to three generations have been recorded in southern France. Flights occur at the end of June/early July and in August/September. Defoliation is caused by the caterpillars in May/June and in the summer. The pupae are inside the boxwood's branches. Young larvae stop developing in the autumn when they enter diapause. They do not come out of this until the end of winter, after a sufficient cold period, and then resume their activity and feeding in March/April. A study of the box tree moth's colonisation potential in Europe revealed that almost any country could be affected (Nacambo et al., 2014), hence the concerns about this moth.

The box tree moth only attacks boxwood, but almost all boxwood species and cultivars are vulnerable. If left untreated, an attacked boxwood will die after two to three generations. In the case of cultivated boxwood, there can be economic and tourism-related consequences. In the case of wild boxwood, there have been consequences on unique ecosystems, namely the ancient boxwood forests of Grenzach-Wyhlen and Bettingen in Germany and Tagolsheim in France, all ravaged by the box tree moth in recent years.

Short-term solutions are currently being studied under the SaveBuxus® project in France (cf. presentation by Jean-Claude Martin of INRA). In the long term, work will be focusing on classic biological control which involves introducing natural enemies collected from the moth's native geographical region where the moth is kept naturally in check. Research has been conducted in Asia where parasitic wasps have been recorded. This work has currently been suspended due to lack of funding.

Open-floor discussion

Jérôme Jullien advised that there are no specific phytosanitary controls at European entry points since boxwood blight and the box moth are not subject to regulations and the *Buxus* genus is not listed in the European Plant Health directive.

One participant reported the effectiveness of a product available on the Swiss market and wondered if it would be possible for this product to be approved for general sale in France. Jérôme Jullien explained that marketing authorisations for phytosanitary products were only valid in the country in which they were filed. The filing process is also relatively long.

JEAN-CLAUDE MARTIN, INRA

About the speaker and his organisation

Jean-Claude Martin is director of the Entomology and Mediterranean Forest Research Unit (UEFM) at the National Institute for Agricultural Research (INRA) in Avignon. A researcher specialising in forest Lepidoptera management, he has for many years been working on alternatives to chemical pest control, particularly the use of traps.

He is coordinating trap research for the Box Tree Moth component of the SaveBuxus® programme.



Box tree moth – Plante & Cité©

Session aim. The presentation focused on various techniques for managing the box tree moth and the latest research conducted under the SaveBuxus® programme (particularly traps and egg parasitoids).

Session content

Experiments conducted on traps under the SaveBuxus® programme focused on the following:

- Comparison of different trap models:
 - o Funnel traps are better for monitoring than glue traps or Procerex®-type traps.
 - o INRA has developed a prototype for large-capacity traps as effective as the funnel trap but easier to use. This non-saturable trap uses no water. Once installed, it can remain in place for the entire season. It is expected to be marketed under the brand name Buxatrap® in the second half of 2015 or no later than 2016.
- Installation height: the traps should be installed approximately six feet above ground since installing the traps at ground level risks trapping more non-targeted organisms such as lizards and small rodents.
- Comparison of different diffusers: the pheromones currently marketed in France are not very attractive. However, the experimental pheromone currently being trialled appears to be very attractive. Moreover, it remains effective throughout the season and so doesn't need to be changed every 4–6 weeks, as is the case with other available pheromones.

In addition, mating disruption, which consists of saturating the air with pheromones to disrupt moth reproduction, is being tested under the Optim'phero research programme. The pheromone used is supplied in a biodegradable medium making it an innovative and sustainable alternative to traditional diffusers.

Work being done on egg parasitoids (spearheaded by Elisabeth Tabone at the INRA UEFM biocontrol laboratory) under the SaveBuxus® programme consists of finding a strain that could be used on moth eggs. Some 60 strains in the INRA registry (Trichogramma) have already been tested. Of these, a number are showing promise – up to 12 eggs killed per Trichogramma female, and three to four Trichogramma eggs laid per moth egg. There may be other naturally occurring parasitoids in France, but identifying them means collecting moth eggs and sending them to a biocontrol laboratory for analysis.

Lastly, work carried out on entomopathogenic agents has confirmed the effectiveness of Btk on caterpillars. However, experiments conducted at multiple sites have shown nematodes to be unsuitable.

Open-floor discussion

It was agreed that water traps were still needed for monitoring since it was easy to count the number of trapped moths and therefore establish flight curves.

For maximum effectiveness, phytosanitary treatments should be applied as soon as the caterpillars become active in the spring. If necessary during the season, Bt-based treatments can be applied 10 days after flight peaks are reported.

With regard to predation of box tree moth larvae by birds, there have not yet been any specific studies on this. Predation on larvae by tits has been reported in France. If confirmed, this could form part of a long-term protection strategy. All species combined, predation rates on larvae remain low. Part of the reason is the time required for birds to adapt to this new prey (as reported for the pine processionary larvae, for example). The phenomenon could therefore become more common year on year.

The box tree moth and dieback diseases are rarely observed together. This suggests for now that the feeding damage caused by box tree moth larvae is not the entry point for the fungus, since *Cylindrocladium* is not a weakness parasite. So far no scientific work has been done on the subject.

The use of high-pressure sprays to dislodge box tree moths is not recommended. This technique creates a suffocating surface-sealing crust on the soil. Furthermore, it encourages moisture at the stem of the boxwood which can promote the development of dieback-causing fungi. Also, the leaves of some boxwood varieties are too fragile to withstand the force of the spray.

PANEL SESSION: “WHAT ARE THE SOLUTIONS FOR OUR GARDENS, GIVEN PHYTOSANITARY REGULATIONS, CURRENT DISEASES AND COST AND MANAGEMENT CONSTRAINTS FACED BY MANAGERS, OWNERS AND GARDENERS?”

Moderator: Philippe Collignon, garden journalist

Panellists:

- Denis Mirailié, landscape architect
- Jérôme Jullien, epidemiological surveillance specialist at the French directorate-general for food safety (Ministry of Agriculture)
- Frédéric Sichet, garden historian
- Patrick Borgeot, head gardener, Vaux-le-Vicomte estate
- Maxime Guérin, research specialist at Plante & Cité and SaveBuxus® consortium member
- Mark Jones, grower of ‘Les Buis de Beausseré’ boxwood
- Jean-Michel Sainsard, park and garden specialist with the French Ministry for Culture and Communication.

Summary of discussions

Philippe Collignon (PC) to Patrick Borgeot (PB): *As head gardener at Vaux-le-Vicomte, you are obviously anxious to find immediate solutions to combat dieback diseases and the box tree moth. Can you tell us more about what you are looking for today?*

PB: I’m still waiting for concrete solutions. *Buxus sufruticosa* is extremely difficult to save. Any solution would at least keep things at bay. Uprooting boxwood, working the soil and recreating designs using lawn are all possibilities until such time as we can reintroduce healthy boxwood along with effective solutions for controlling dieback diseases.

Philippe Collignon (PC) to Frédéric Sichet (FS): *As a historian, what would it mean to you if there was no more boxwood? What do you think a 19th-century gardener would have done? Change plants? Introduce a combination of solutions?*

FS: Based on what we’ve seen, there are currently no miracle solutions, but rather a range of solutions that could be helpful in combination, such as prevention through proper watering, one-off treatments and avoiding the introduction of diseased plants. For historic gardens, though, it should be noted that there are no suitable solutions. As a result, there will be less restoration of boxwood. We’ve been through plant-health crises before, with Dutch elm disease and canker stain of plane trees, which led to substantial felling including plane trees in historic arcades. These problems are not new to historic gardens.

Philippe Collignon (PC) to Denis Mirailié (DM): *What changes and practices need to be implemented to deal with the phytosanitary issues affecting boxwood?*

DM: My involvement is more that of advocate for the gardening profession. I think we are resorting too much to chemistry and forgetting the craft and expertise of the gardener. Banning pesticides in gardens is certainly a good thing. No pesticide should be exempt when it comes to historic gardens; we have an opportunity to take a different approach and come up with new practices, like for watering.

When we plan a garden, we consider life in the garden to be very important. The aim is to introduce more life into gardens and especially into the soil, which is too often overlooked because it is compacted and

forgotten yet contains pesticide residues. Less life in the soil contributes to dieback and makes trees and shrubs such as boxwood more susceptible to disease.

The box tree moth, which is an exogenous insect, poses a different problem and raises questions about the health of plants in nurseries or retail outlets. Ensuring they are unaffected is crucial to containing this problem. In general, we need to take a more holistic approach to garden management.

PC: *Is it possible that plants not planted in the right place will be more susceptible?*

DM: You could, in some cases, blame poor planting and management practices for creating greater susceptibility to disease. However, we are seeing substantial damage related to the box tree moth and dieback diseases in genetically diverse populations of boxwood. This justifies our concerns about the current situation but we must continue to trust in nature and remember what happened with elm (ravaged by Dutch Elm disease), which is now starting to be replanted. Some of the elm that was kept allowed us to identify natural resistance and this is now being used to create new resistant varieties, which is what we hope for boxwood.

Philippe Collignon (PC) to Maxime Guérin (MG): *You are part of the SaveBuxus® consortium. What can you tell us about the research and work being done on the box tree moth?*

MG: We have been working with our SaveBuxus® partners on biocontrol solutions to combat the box tree moth in the most sustainable and eco-responsible way possible. We are also working on the moth's biology, about which little is known in France. Knowledge of the biology is important for implementing a pest control strategy that will target different biological stages and be adjusted according to France's different climate regions.

PC: *To that point, is this knowledge now available?*

MG: Last year, the flights of box tree moths were tracked in different regions in addition to the biological monitoring coordinated by France's general directorate of food safety (Ministry of Agriculture) and implemented by the regional plant clinics. This work will continue to refine our knowledge of overwintering which is the cause of the first damage in spring and during emergence periods. The programme has also benefited from information about the amount of boxwood we have in France, with particular support from the central region parks and gardens committee which conducted a national survey of garden owners to quantify boxwood. Thanks to this information, we now know that there is a lot of boxwood in parks and gardens and that it plays a huge role in our heritage gardens.

PC: *Are the solutions proving effective?*

MG: There are a number of solutions available or undergoing improvement that need to be combined if they are to prove effective at combating the box tree moth. Solutions to control caterpillars and moths are particularly effective. The SaveBuxus® programme is also working to develop a method to control the egg stage, which would then affect all development stages of the box tree moth as part of a holistic strategy. There is still a lot of work to be done before we have an optimal holistic strategy.

PC: *Is it possible to intervene at all larval stages?*

MG: As far as the caterpillars are concerned, the earlier we intervene, the more we optimise the effectiveness of Bt (*Bacillus thuringiensis*)-based treatment products.

PC: *How far back do these solutions go? How old are the available data?*

MG: The work didn't start until 2014 and monitoring the box tree moth's biology only began three or four years before that as part of France's biological monitoring. There is not a long history.

PC: *Do we know if the box tree moth has evolved or mutated?*

MG: It's still too early to say. What we have noticed is that the number of generations could be as many as four in some regions, but this still has to be confirmed through additional research in 2015.

Philippe Collignon (PC) to Jean-Michel Sainsart (JMS): *As a garden specialist for the French Ministry for Culture and Communication, you are at the forefront of current issues. What is the Ministry's stand in the face of this attack? Another question, supposing a château has a listed garden containing boxwood and the owner wants to get rid of it, what would be the Ministry's position on this?*

JMS: The Ministry exercises scientific and technical control over historic gardens and national estates. We began discussing this some months ago and it's still ongoing, but we have decided to offer funding to Plante & Cité. Funding has yet to be confirmed for the SaveBuxus® programme, though. More generally, the Ministry has a policy specifically covering historic gardens.

As was mentioned earlier, this is not the first time historic gardens have experienced damage. During the 20th century, two major wars wreaked havoc on a number of historic gardens, either partially or completely destroying them. A profession and skills have also disappeared. It is a downward spiral. Historic gardens are encountering multiple problems: senescence, disease, decline and now two new phytosanitary issues affecting boxwood. It is yet another test faced by garden owners and managers.

With regard to the boxwood problems, the Ministry has the same approach to gardens as it does to everything else. The key to the garden is not simply its plants. We've been hearing about boxwood since this morning. Of course – it's the theme of this event. But when we talk about gardens, it's more than that, because boxwood is just one element. I don't believe for one moment that the beauty of Vaux-le-Vicomte is solely its boxwood parterres. You have to look at it as a whole, as a composition. We protect a garden not for its plants but for art and history. So we have to take each case individually. One day it might be Vaux-le-Vicomte, the next, Champs-sur-Marne or any of the great gardens with parterres and formal layouts. The Ministry acts according to the seriousness of the diagnosis, not just in terms of plant health but the site itself. Gardens are heritage sites that first must undergo a diagnosis of its soil, water, history and composition.

To answer the last question about plant choice, I'll use the example of the Tuileries Gardens, which underwent a contemporary upgrade in the 1990s. You mustn't think that the Ministry is only interested in restoration. In other words, putting boxwood where there is boxwood. That's not the spirit of the Ministry's intentions!

On the other hand, if you appeal to one of France's architectural heritage architects to point out that boxwood is being uprooted because it is diseased, that's not acceptable either. There has to be a minimum diagnosis if you're going to implement a new project that could lead to a contemporary garden. Here, at Vaux-le-Vicomte, we have a garden whose history has been known ever since Le Nôtre created it. From this room, if there wasn't a curtain we would have a view of the château's outdoor areas but no view of the plants. What the garden boils down to is basically a series of full and empty sections and, in the case of a 300 to 400 year-old historic garden, some permanent features. It is these permanent features to which we are attached. If Alexandre de Vogüé wants to create a contemporary garden, the Ministry will ensure that these permanent features and these empty and full sections which make the garden what it is today are safeguarded.

Philippe Collignon (PC) to Jérôme Jullien (JJ): *You are an agro-environmental engineer with a holistic approach to the phytosanitary problems facing boxwood, meaning you advocate monitoring and integrated pest management. What avenues are you exploring?*

JJ: Being responsible for France's biological monitoring on behalf of the Ministry of Agriculture and for the epidemiological surveillance network, which publishes bulletins on plant health, I believe it is important to work as a network. Setting up the SaveBuxus® consortium was very wise. Working as a group means we can bring together skills that will be useful in combating the box tree moth and dieback diseases.

Two or three years ago, we had thought about getting Plante & Cité involved in this issue to lead discussions and organise seminars like the one today. Clearly it is important that first of all we exchange information and improve our handling of the diagnoses, as Madame de Curel pointed out in her

presentation this morning. Otherwise we risk delaying the implementation of management solutions and best practices.

Next there is epidemiological surveillance which is being stepped up for the box tree moth but has yet to be developed for dieback diseases.

And lastly, there is the development of integrated pest management with its current and upcoming solutions for the box tree moth. As Maxime Guérin pointed out, methods based on Bt (*Bacillus thuringiensis*) and the prospects for developing mating disruption and mass traps are promising. Biological pest control using parasitoids also has interesting potential. On the other hand, for dieback diseases, the problem is once again pressing. Dieback-causing fungi are not new. *Volutella buxi*, for example, was reported in the 1970s. The arrival of *Cylindrocladium buxi* has created regions that are conducive to the expression of both pathogens, resulting in one highly virulent pathogen complex, especially for susceptible cultivars.

Remember that for a disease to develop, it has to overcome three barriers of a plant's natural defences: the genetic barrier, the physical barrier and the biochemical barrier. If the disease overcomes these three barriers, compatibility is established and it can develop. Integrated pest management involves tackling each of these barriers, which means pursuing natural regulation methods at the same time as allowing treatment products to be applied if necessary and at appropriate intervals.

With regard to the genetic barrier, we have talked a lot about research on resistant or tolerant cultivars, and in fact we are now seeing genetic variability in boxwood.

As for the biochemical barrier, studies on natural defence stimulators are in keeping with the Ministry of Agriculture's desire to reduce the use of synthetic phytosanitary products. Although the amended Labbé Act ("Act of 6 February 2014") called for by France's Ministry for Ecology has been implemented, the ban on pesticides in gardens and green spaces will not go into effect until the January 2017.

With regard to the physical barrier, this requires plant growers to get involved in boxwood cultivation methods. What we are noticing in practice is that the health of boxwood plants is being impacted by a whole series of factors, including land take, growing boxwood within very short time periods and fast-growing clones. The plants are therefore more vulnerable when exposed to pathogens, especially when climate conditions are right. We therefore have to rely more on the plant health networks. For gardens and green spaces, the FREDON plant clinics have laboratories and resources for biological monitoring. By monitoring residual fungal forms, it's possible to see and predict the pathogen's development phases. This can be useful for timing treatments more effectively, even treatments based on biocontrol products. This is a simple method already being done for other fungi such as eyespot and downy mildew, where an artificial inoculation technique is used for monitoring fungal development in several regions. In the case of *Cylindrocladium sp.*, being part of a network means we can issue newsflashes in Plant Health Bulletins to announce imminent contaminations, high spore counts, contamination phases, and so on. Without this, treatments are random.

PC: Is there a way to share this information in France, or does everyone just keep their observations to themselves?

JJ: This is precisely the aim of the SaveBuxus® programme, so that people don't have to work alone. You have to keep a record of people's experiences in order to find solutions more quickly.

I work for a department responsible for protecting plants so we operate on the premise that boxwood has to be protected. That means mobilising experts in these areas. But again, there is no escaping biological and epidemiological factors. If we can't control them, there will be no effective pest control methods either for professional or amateur gardeners about whom we have not talked very much today. Biological monitoring in private gardens is the subject of methodological research work currently being carried out by the French National Horticultural Society.

PC: To that point, what do we know about the seriousness of phytosanitary problems in boxwood in private gardens? What's being done about it?

JJ: Several regions have already agreed to establish epidemiological surveillance networks for private gardens, including the Loire, Provence-Alpes-Côte d'Azur and Nord-Pas-de-Calais regions. If funding is set up under the Ecophyto plan, we will be able to monitor more than one million hectares. This is significant,

not least in terms of the use of phytosanitary products since private usage accounts for 80% of the market compared to professionally maintained parks and gardens. Echoing what Patrick Mioulane said this morning, it is also important for plant protection firms that are developing biocontrol or more traditional products to assess the market to determine the potential ROI, since these firms invest heavily in R&D.

Philippe Collignon (PC) to Mark Jones (MJ): *You are a boxwood grower. Do you think the solution is to find a new resistant clone?*

MJ: I have two answers to that. With regard to the box tree moth, I don't think that's the answer because the species is subservient to box. Also, as we saw this morning, solutions being studied under SaveBuxus® are promising. Having participated in the programme's initial meetings, I've noticed an astonishing progress in solutions and this is very encouraging. As for *Cylindrocladium*, this is more complicated and worrying. I have a lot of empathy for the gardeners at Levens Hall who hand-trim most of the boxwood as we've heard, and I also understand the stress that Patrick Borgeot defined so well.

I have no scientific authority when I say that resistant clones are one avenue, but unquestionably that is the most likely path if we are to avoid the disappearance of boxwood. Even if it looks doubtful, I still have hope. Pragmatically, it's clear that antagonist fungi are a possibility, but this is still at the very early stages.

PC: *Jérôme Jullien talked of cultivation methods that play a key role in the expression of the disease. As a boxwood grower, have you noticed this too?*

MJ: First of all, I hope Jérôme Jullien was not thinking of me when he said that! Seriously, though, it's important to be aware that growing boxwood is not French. There are half a dozen of us in France growing boxwood almost exclusively but I think I'm the only one doing nothing but that. There are no customs statistics on boxwood but we do know that there are only three machines that trim boxwood into balls in France and over 200 in Belgium and the Netherlands. This gives you an idea of the balance of power and the way the markets are organised! In France, there is the huge garden-centre market and you have to be organised to do it. It doesn't apply to me because I only serve the heritage-garden market, which is different. For example, I don't use fertiliser. For this market, cultivation is key and head gardeners of these estates know it. Many of them come to check on the boxwood they'll be buying while it's still growing. As with landscape architects, you can't hide the truth from them!

Q&A:

Jeanne Emma Graciet – Château de Viven: Château de Viven is located north of Pau and probably exposed to a different climate to those we've discussed so far today. Part of my garden is listed in the National Heritage Site Additional Inventory (<http://chateau-de-viven.com>). It has been restored to how it was in the 18th century, with ancestral boxwood more 200 years old in perfect health. Of course, the boxwood edging posed a problem. Having worked as a pharmacist specialising in homeopathy, I was tempted to use the isotherapy method, which was used in human medicine until the 1980s. Since AIDS came on the scene it has been prohibited in human medicine but I was able to try it in my garden for four years. The results are starting to look good and I would like to involve volunteers in this work to get more feedback. The advantage of this method is that when the sick parts are removed, so are all of the plant's enemies, whether visible or invisible. Homeopathic remedies are financially very affordable. I would like to continue this experiment as a community and want to emphasise that I am not selling anything.

Jérôme Jullien: It involves stimulating a plant's natural defences, which is the case with some of the products currently being tested, but we're obviously not at the stage of a repeated experiment that would allow us to scientifically measure its acknowledged effectiveness. However, it should be done to see if it is genuinely effective and also to understand how the product works and at what level of the plant so that we can improve its use in the event of an effective outcome.

With regard to products available on the market, there are plant-strengthening products that improve the plant's physiology. There are also products with the proven ability to limit mycelial growth in plants. This comes under biochemistry and is quite complex but might be a solution in the future.

Mortimer de Lassens: My family's garden is also a listed garden. We have encountered many *Volutella*-type problems. We don't have access to Plante & Cité and haven't had any advice or diagnosis. Also, the solutions presented this morning seem to apply only to big gardens and parks.

Maxime Guérin: The solutions being worked on under SaveBuxus® could be tailored even to very small gardens. Obviously the results will be made public and are intended for everyone.

Mortimer de Lassens: Whom should we contact for a diagnosis? We feel we're on our own and powerless.

Jérôme Jullien: There are no longer any diagnostic laboratories in the regional plant protection departments but there are many other laboratories that can perform an analysis. [Another participant said that there was one in Bordeaux.]

Jérôme Jullien: As previously mentioned, diagnosis is crucial for protecting private gardens. One thing we can do is provide a list of laboratories that can do a general epidemiology diagnosis (see appendix). This list was published in an issue of the magazine Phytoma. There is also a website where individuals and amateur gardeners can find plenty of resources on best practice and preventative measures. The site is called www.jardiner-autrement.fr. Contractors can also perform a diagnosis and provide advice to individuals.

Mark Jones: If a poor diagnosis is made, pesticides end up being misused. It is therefore very important to do things correctly and work with competent organisations. Personally I use the services of the FREDON Centre plant clinic and that works very well. It's still not possible to distinguish between *Cylindrocladium* G1 and G2 but it's just a matter of time.

Patrick Borgeot: If it makes other garden owners feel better, we also sometimes feel alone here at Vaux-le-Vicomte. We have been battling *Volutella* for several years now and organised this meeting precisely to remedy that and get serious practical and scientific solutions. We have also been given a realistic assessment of the outlook. I receive numerous suggestions of miracle solutions and although some may work, what I need is proof. This event really shows that so far, no one has found a miracle solution that works perfectly against these diseases. The diagnosis made by the FREDON Centre was also very useful to me.

Philippe Collignon: Will the Ministry for Culture act so that these owners will not feel so powerless?

Jean-Michel Sainsart: As far as boxwood disease is concerned, that's not a task for the Ministry for Culture and Communication. We are in contact with garden associations which any owner can join to get more information and feedback. The Ministry is tasked with preserving and safeguarding heritage gardens but not protecting the plants, which falls to the Ministry of Agriculture.

Mark Jones: This doesn't apply to me but I think you need to contact the right people for a diagnosis. Once again, I recommend the FREDON Centre plant clinic.

Jean-Michel Sainsart: Regional cultural affairs directorates can't deal with issues relating to disease diagnosis but we can respond to conservation issues. For example, we are currently supporting a listed garden that has a plane tree grove affected by canker stain. I think that confusion usually arises when no diagnosis has been made, so it's important to contact professionals whose job is to provide diagnoses.

Philippe Collignon: As we heard from Patrick Borgeot, soil is very important and we don't always know our soil that well. Soil can change due to a new drainage system or a change in climate, for example, and this is one of the factors to take into account under a holistic approach.

Participant: I don't think we should be setting ourselves limits because phytosanitary diagnoses are not expensive and are very useful. There are also some very effective associations out there that make sure the results of this research are made available to everyone.

Eric Chapin (COSAVE): I'd like to add something about diagnoses and recommendations, which are two very distinct things. First you have to take a sample and send it to a laboratory whose analysis methods can vary in terms of precision. In more complex cases, a mycological or genetic analysis might be needed to determine the strain of the fungi. After this phase, a pest control strategy has to be implemented combining the available methods, namely biological, cultivation and environmental methods and, as a last resort, pesticides. When applying them, you also have to make sure you comply with best practice and application techniques. For example, for boxwood, we know that the product applied does not always reach the target. Afterwards, you have to conduct an annual review and adjust the strategy if necessary.

Philippe Collignon: I will let Patrick Borgeot and Alexandre de Vogüé conclude this event. Thank you so much both of you for showing us around the gardens and giving us a better understanding of the current issues facing boxwood.

Patrick Borgeot: Thank you all for coming. This event has been an opportunity to take stock of the situation. I hope it has given all of you a lot to think about. I also hope that we will soon have effective solutions available. I would like to thank BAHCO, Les Gazons de France and the Fondation des Parcs et Jardins de France. Thanks, too, to Plante & Cité and all the presenters who have worked with us. They are part of the family!

Alexandre de Vogüé: The most important things have been said. I, too, feel less alone today. At Vaux-le-Vicomte we have resources very similar to those of many of you and today we have discovered a mutual desire to share our experiences, solutions and tips. But we mustn't forget that all solutions must be scientifically validated, even if this seems a long process. It's the prerequisite for being able to use boxwood again. And if it's not boxwood, it will be other plants. Let's be humble in the face of nature! Thank you, everyone, for taking part.

NB: We apologise to the participants if the comments and presentations have not been reported in their entirety in these proceedings.

LIST OF LABORATORIES THAT OFFER PHYTOSANITARY ANALYSES OF BOXWOOD (MEMBERS OF THE FRENCH PLANT PROTECTION NETWORK)

The table below provides a list of analysis laboratories approved by the French plant health network to identify fungi and oomycetes. In the event of difficulty in finding a laboratory with fungi identification skills, we recommend that you seek advice from a technical advisor to steer you in the right direction.

Laboratory	Address	Person to contact for technical information on analysis services
FREDON de Picardie	19 bis rue Alexandre Dumas 80000 AMIENS	plasue.fredonpic@orange.fr

	<p>Tel : +33 (0)3 22 33 67 10 Fax : +33 (0)3 22 33 67 18 http://www.fredon-picardie.fr/fredonpicardie@wanadoo.fr</p>	
Laboratoire Départemental d'analyses du Bas-Rhin	<p>2, Place de l'Abattoir 67200 STRASBOURG Tel : +33 (0)3 69 33 23 23 Fax : +33 (0)3 69 33 23 00 Lvd67@g67.fr</p>	frederic.pate@cg67.fr
Laboratoire Vétérinaire et Alimentaire Départemental de Meurthe et Moselle	<p>BP 60029 – Domaine de Pixerecourt 54220 MALZEVILLE Tel : +33 (0)3 83 33 28 60 Fax : +33 (0)3 83 21 52 46 Lvd54@g54.fr</p>	cgenay@cg54.fr
Eurofins Laboratoire de Phytopathologie	<p>81 bis Rue Bernard Palissy 62750 LOOS-EN-GOHELLE Tel : +33 (0)6 47 69 23 04 http://www.eurofins.fr ServiceClientELPV@eurofins.com</p>	marchumbert@eurofins.com
Clinique des Plantes	<p>Pôle Protection des Plantes 7 chemin de l'IRAT Ligne Paradis 97410 Saint-Pierre LA REUNION Tel : +33 (0)2 62 49 92 15 Fax : +33 (0)2 62 49 92 93 http://www.fdgdon974.fr cliniquedesplantes@fdgdon974.fr</p>	janice.minatchy@fdgdon974.fr
Laboratoire Départemental d'Analyses des Bouches-du-Rhône	<p>Technopôle de Château Gombert 29 Rue Joliot Curie 13013 MARSEILLE Tel : +33 (0)4 13 31 90 00 Fax : +33 (0)4 13 31 90 14 Lda13@cg13.fr</p>	sophie.tiliacos@cg13.fr
LABORATOIRE COMITE NORD PLANT	<p>Rue des Champs Potez 62217 ACHICOURT Tel : +33 (0)3 21 60 46 60 Fax : +33 (0)3 21 60 46 62</p>	xavier.rigueiz@comitenordplant.fr
LABORATOIRE LCA	<p>39 RUE Michel Montaigne B.P.122 33294 BLANQUEFORT Cedex Tel : +33 (0)5 56 35 58 60 Fax : +33 (0)5 56 35 58 69 http://www.laboratoirelca.com</p>	francois.poul@laboratoirelca.com

Laboratory	Address	Person to contact for technical information on analysis services
GEVES Laboratoire de pathologie	<p>25 Rue Georges Morel CS 90024 49071 BEAUCOUZE Cedex Tel : +33 (0)2 41 22 58 50 Fax : +33 (0)2 41 22 58 01 valerie.grimault@geves.fr http://www.geves.fr</p>	valerie.grimault@geves.fr
Laboratoire Santé des Végétaux, unité mycologie	<p>Domaine de Pixérécourt, Bât. E 54220 MALZEVILLE Tel : +33 (0)3 83 29 00 02 Fax : +33 (0)3 83 29 00 22</p>	renaud.ioos@anses.fr

	nancy.lsv@anses.fr http://www.anses.fr	
Fredon 45 – Clinique des Plantes	13 Avenue des Droits de l'Homme 45921 ORLEANS Cedex 9 Tel : +33 (0)2 38 71 95 73 Fax : +33 (0)2 38 70 11 51 cliniquedesplantes@fredon-centre.com http://www.fredon-centre.com	maryse.merieu@fredon-centre.com
Fredon 31 – Clinique du végétal	Parc Technologique du Canal 3 rue Ariane, bât B CS 82245 31522 RAMONVILLE SAINT AGNE Cedex Tel : +33 (0)5 62 19 22 30 Fax : +33 (0)5 62 19 22 33 laboratoire@fredec-mp.com http://www.fredec-mp.com	nathalie.eychenne@fredec-mp.com
Laboceia – Phytopathologie	5 et 7 rue du Sabot CS30054 22440 PLOUFRAGAN Tel : +33 (0)2 96 01 37 22 Fax : +33 (0)2 96 01 37 50 contactlda@laboceia.fr http://www.laboceia.fr	pascale.lamanda@laboceia.fr

Note: Before sending any samples, please contact the laboratory to find out the time limits for sending samples and procedure for preparing the plant samples to be analysed.