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Phytophthora disease of alder (*Alnus glutinosa*) in France: investigations between 1995 and 1999

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Summary

A severe decline of alder associated with an undescribed *Phytophthora* species was identified for the first time in England in 1993. No generalized decline of alder was reported in France before 1990. The first diebacks and mortalities of common alder were observed at the beginning of the 1990s, but the so-called alder *Phytophthora* was not isolated in France until 1996. First, a synthesis about alder declines that were known in France before 1995 is presented. Then, a survey was established in north-eastern France; 108 sites were visited and the alder *Phytophthora* was isolated from 57 of them. All the main rivers were found to be affected and damage levels are significant along some of them. The frequency of the alder *Phytophthora* and other fungi isolated from declining alders is discussed. Finally, information on other alder declines in France is presented region by region, and a map summarizes the known distribution of the disease. The alder *Phytophthora* is quite common and widespread in France, with western and north-eastern France being especially affected; however, the number of diseased or dead trees varies greatly from one site to another. All records are from *Alnus glutinosa*; other *Alnus* species were seldom seen in the surveys.

1 Introduction

In France, common alder *Alnus glutinosa* (L) Gaertn. is distributed along streams and rivers and dominates in certain types of wet woodland ecosystems. It is increasingly planted in programmes of riverbank restoration, sometimes in combination with other tree species.

A severe dieback of alder associated with an undescribed *Phytophthora* species was recognized for the first time in England in 1993 (Gibbs 1995). The causal organism was described as an unusual form of *Phytophthora cambivora* and, pending a full description, named the 'alder *Phytophthora*' (Brasier et al. 1995). It has subsequently been shown to comprise a range of heterodiploid interspecific hybrids involving a *Phytophthora cambivora* (Petri) Buisman-like species and an unknown taxon similar to *Phytophthora fragariae* Hickman (Brasier et al. 1999).

In 1995, the LNPV (Laboratoire National de la Protection des Végétaux de Nancy), the INRA (Institut National de la Recherche Agronomique) and the DSF (Département de la Santé des Forêts) began to search for this pathogen in France at the request of the European Union. It was first discovered in 1996, simultaneously near Nancy (LNPV Nancy) and in Landes in south-western France (DSF Sud-Ouest and INRA Bordeaux). In this paper, alder decline reports before 1995 are reviewed, the results of the LNPV survey in 1997–98 in north-eastern France are described, and information on other alder diebacks discovered since 1995 in France are discussed.

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2 Alder dieback reports in France before 1995

Until the establishment of the DSF in 1989, there was no organized system of monitoring tree diseases in France. However, it does not seem that any important disease had occurred on common alder during the preceding period. MATHIEU (1995) assembled available information which showed that during the period 1987–95, there were only a few reports of damage (Table 1). This damage was usually associated with a lack of water (drought, variation in ground water level). Frost and insects were sometimes reported but were not really injurious. *Armillaria* spp. were isolated several times, usually in association with drought. Other secondary pathogenic fungi, such as *Melanconium* sp. and *Cryptosporiopsis* spp., were also reported.

However, three records from this period are of considerable interest:

1 In southern France (Roussillon) in 1988, a *Phytophthora* species identified as *P. cambivora* was isolated from *Alnus cordata* (A. BAUDRY, LNPV Bordeaux, personal communication).

2 In south-western France (Landes) in 1991, mortality was observed in natural woodland on the banks of the lake of Léon. The severe droughts of 1989–91, attacks by the bark beetle *Taphrorychus bicolor* Herbst (*Coleoptera*, *Scolytidae*) and defoliation caused by *Agelastica alni* L. (*Coleoptera*, *Chrysomelidae*) were mentioned to explain these diebacks. However, in 1996, damage increased and the alder *Phytophthora* was isolated (C. ROBIN, personal communication). At the end of 1997, 35% of the trees showed typical symptoms and 11% were recently dead (DSF Sud-Ouest, 1997, unpublished data).

3 In north-eastern France in 1993, significant mortality was observed near Sélestat (Alsace) on a moist forest site. What are now known to be typical symptoms of Phytophthora disease were observed, but attempts to isolate *Phytophthora* failed in 1993, 1995 and 1997. *Armillaria gallica* Marxmüller and Romagnesi, *Cryptosporiopsis* spp., *Phoma* sp., and *Cylindrocarpon* sp. were isolated; these fungi colonize weakened trees and the exact causes of mortality remained unknown, although drought was mentioned as a possible explanation. In 1998, the alder *Phytophthora* was isolated from several symptomatic trees including one tree sampled in 1995 (DSF Nord-Est, 1993, 1995, 1998, unpublished data).

3 Alder dieback in north-eastern France: the 1996–99 survey

3.1 Survey and assessment procedures

The LNPV of Nancy, the Agence de l'Eau Rhin-Meuse and the DSF were involved in 1996 and 1997. Survey forms (asking for sites, a brief description of symptoms, damage and ecosystem) and a short illustrated note were sent to partners of the Agence de l'Eau and the DSF observers.

Reports of possible disease sites were followed up with visits by staff of LNPV in 1997 and 1998 in order to check the presence of symptoms and to take samples for analysis. Visits were also made to all the main rivers of the area (Moselle, Meurthe, Meuse, Sarre, Ill, etc.) but smaller streams were not all visited. A few additional sites were visited in 1999.

Diseased trees were detected by external symptoms (small and yellow leaves, tarry spots and exudations, etc.). About three trees were sampled from each site: a piece of bark was sampled from the outer edge of the necrotic lesion at the base of the trunk, wrapped in a plastic bag and brought to the laboratory at ambient temperature. Details and efficiency of the method used to isolate the alder *Phytophthora* are discussed in STREITO et al. (2002).

Table 1. **Alder declines in France before 1995 (sources CEMAGREF[1]/DSF[2]/LNPV[3]), after MATHIEU (1995)**

Date	Region	Name of the site	Characteristics of the site	Other important observations	Symptoms, and diagnoses
1978	Aveyron Haute Garonne Lot Tarn		River banks	Significant mortality	Top dieback, dryness, Chrysomelidae, successive defoliations by phytophagous insects
1982	Alpes maritimes	St Dalmas le Selvage		Sparse declines	Top dieback
		St Etienne de Tinée			
	Charente	Sèvre nantaise	River banks	Mortality	Top dieback
	Var	F. D. des Maures Chatain		Sparse decay, *A. glutinosa* and *A. cordata*	*Melanconium* sp. canker, early frost
1983	Aveyron	Salmiech	River banks	First dieback 1975/76	Top dieback, Chrysomelidae, water variation of the ground level (dryness 1976, 78, 82)
		Aurelle-Verlac	River banks	Significant declines	
	Haute Garonne	Anzas-Montastruc	River banks	Significant declines	*Armillaria*, Chrysomelidae, dryness
		Marignac-St Paulet	Plateau	–	Top dieback, dryness
		Vaudreville	Plateau	First observation 1980	Chrysomelidae, dryness
		Antignac	Valley bottom	Significant declines	Chrysomelidae, dryness
		Aspet	River banks	First observation 1982	Top dieback, dryness
	Lot	St Gery	River banks	Significant declines	*Armillaria*, top dieback. Severe drought, particularly 1982 summer
		Ste Colombe-Cazals	River banks	Sparse mortality	Chrysomelidae, *Xyleborus*. Severe drought, particularly 1982 summer
	Tarn	Viane	River banks	Significant mortality, first observation 1978	Cerambycidae, Buprestidae, variation of the ground water level
1990	Corse		By the seaside	All the trees dead	Sandy soil, dryness
	Corrèze		Valley bottom	One spot of mortality	*Armillaria*, dryness
1991	Ain			Mortality	Top dieback, dryness
	Ariège	Castillonnais		Significant mortality	
	Landes	Léon	Lake, forest	Sparse mortality	No pathogenic fungi
1992	Landes	Léon	Lake, forest		*Fusicoccum* or *Macrophoma*?
	Dordogne		River banks	Mortality since 1976	Dryness
	Bas-Rhin	Brumath	Alluvial plain	Sparse declines	Tarry spots, *Cryptosporiopsis*
		Gambsheim	Alluvial plain	Sparse mortality	Bark necrosis at the base of trunk
		Plobsheim	Alluvial plain		Top dieback/tarry spots, *Armillaria*

Table 1. **Continued**

Date	Region	Name of the site	Characteristics of the site	Other important observations	Symptoms, and diagnoses
1993	Gers		Valley bottom	Significant mortality	*Armillaria*
	Landes	Soustons and other sites	Alluvial plain	Sparse mortality	Tarry spots, *Cryptosporiopsis, Botryosphaeria, Armillaria*, Buprestidae
	Bas-Rhin	Sélestat	Alluvial plain		Top dieback, bark necrosis, insects
1994	Bas-Rhin	Sélestat	Alluvial plain		Top dieback, tarry spots, *Cryptosporiopsis, Armillaria gallica, Cryptodiaporthe salicella*
1995	Bas-Rhin	Sélestat	Site subject to flooding	Mortality	*Armillaria gallica, Cryptosporiopsis* sp. *Cryptodiaporthe salicella*
	Bas-Rhin	Sélestat	Alluvial, damp site, edge of a forest path	Mortality	No pathogenic fungi, dryness? Management injuries
	Haut-Rhin	Colmar	Forest with ash and alder	Sparse declines of ash and alder for a few years	No pathogenic fungi
	Vaucluse	Avignon	River banks?		*Cylindrocarpon* sp.
	Meurthe et Moselle	Malzéville	Banks of the Meurthe river, urban site	Mortality of young plantations	*Phytophthora* sp. (*P. cryptogea*??) Site very sunny and white wall reflection

[1] CEMAGREF: Centre National du Machinisme Agricole du Génie Rural des Eaux et Forêts.
[2] DSF: Département de la Santé des Forêts.
[3] LNPV: Laboratoire National de la Protection des Végétaux, Unité de Mycologie Agricole et Forestière.

3.2 Results

3.2.1 Disease distribution

In 1996, 32 forms containing reports of sites with alder dieback were received, with 10 additional ones being received in 1997. Observers mentioned significant damage (20% or more of the trees affected) on over half the sites. It was difficult to date the beginning of the dieback but, on some sites at least, observers agreed that the condition of the alder had been deteriorating for 2 or 3 years prior to 1996.

Between 1996 and 1999, 108 sites were visited and alder *Phytophthora* was isolated from 57 of them. All the main rivers of the Rhin-Meuse basin were found to be affected (Fig. 1). Along the River Moselle, the alder *Phytophthora* was detected in several sites from the foot of the Vosges mountain downstream to Metz. The alder *Phytophthora* was not isolated from samples of the upper parts of the Vosges but crown symptoms were noted at one site at an altitude of 630 m. Along the River Meurthe, the alder *Phytophthora* was found from Nancy to Saint Dié. Along the Meuse, alder trees are abundant upstream of Neufchâteau and near Charleville-Mézières; alder *Phytophthora* was isolated from several sites and damage was significant. The Sarre is the most seriously affected river of the region; dieback is severe and the alder *Phytophthora* has also been isolated from tributaries and adjacent ponds. In Alsace, the alder *Phytophthora* was found along some of the Rhine tributaries, but there has been no report of the disease from the Rhine itself. Damage levels are significant along some rivers (Moder, for example) and alder *Phytophthora* was also isolated in woodland ecosystems flooded by the Ill.

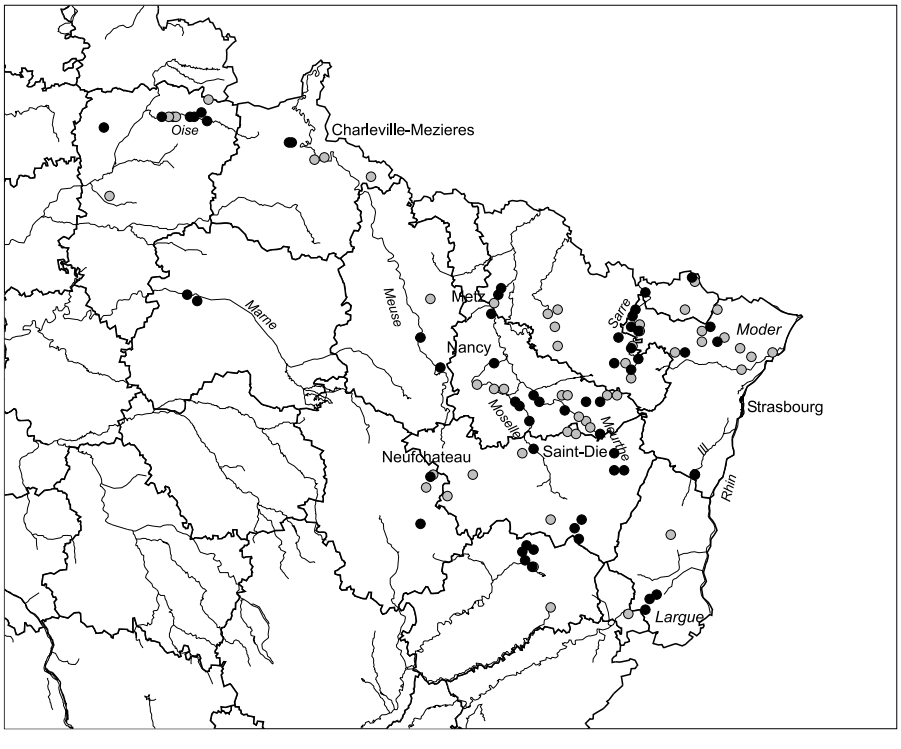

Fig. 1. Sites where alder declines were observed in north-east France (1996–99). Black circles, Alder *Phytophthora* isolated; grey circles, Alder *Phytophthora* not isolated

The majority of records for the alder *Phytophthora* came from riparian trees. However, as indicated above, some cases of the disease have been found on the banks of lakes and ponds and in seasonally flooded forest stands. The disease was also observed in a shelterbelt surrounding a field of grass. No cases of the disease in nurseries have been found. All affected trees were *A. glutinosa*, other alder species being not common in this region. Trees of all ages were affected, from 3 to more than 60 years old. On the same river bank, dead, diseased and healthy trees were often found side by side.

3.2.2 Fungal isolations

Table 2 gives the data on the fungi isolated in 1997 and 1998 according to the alder habitat. In 1997, isolation attempts frequently failed: the alder *Phytophthora* was isolated from only 21% of 68 sites showing dieback. Several aspects of the procedure were evaluated to improve the success rate (STREITO et al. 2002). The quality of the samples collected appeared to be a key factor and in 1998, with improved selection of bark samples, the success rate increased markedly; the alder *Phytophthora* being detected in 75% of the sites with dieback. No other *Phytophthora* species was isolated from trunk lesions.

Under favourable conditions (with fresh necrosis in which the fungus was active), the alder *Phytophthora* was usually the only fungus growing on the isolation plates (in 1998 this was true for 83% of the isolation attempts). From older necroses, the alder *Phytophthora* was difficult to obtain and several other fungi (mainly *Cryptosporiopsis* spp. and *Phoma* spp.) often developed on the plates (Table 2). This was consistent with the view that the alder *Phytophthora* is a primary parasite and is soon replaced by other less pathogenic fungi.

Although only nine forest sites were investigated, it seemed that the alder *Phytophthora* was less often isolated from such sites than from riverbanks, probably because forest sites are generally not subject to flooding. By contrast, *Armillaria* spp. were common. In some cases, the alder *Phytophthora* and *Armillaria* were isolated from the same tree.

Relatively few attempts were made to obtain the alder *Phytophthora* from roots. However, it was successfully isolated from a discrete area of dead bark (10 cm^2) on a main root 5 cm from the base of a stem. *Cylindrocarpon* spp. were readily isolated from roots, in particular strains related to *C. destructans* (Zinssmeister) Scholten, a species common in soil.

4 Disease distribution across the rest of France

With the exception of the north-east, no systematic survey work has been undertaken. Information principally comes from field visits made by the DSF. This is presented by region below and the data for the whole country is summarized in Fig. 2 and Table 3.

Table 2. **Fungi isolated from declining alder trees in the survey of north-eastern France (% of sites examined)**

	Banks (river or pond)		Forest ecosystems		Total	
Year (number of sites)	1997 (59)	1998 (60)	1997 (9)	1998 (9)	1997 (68)	1998 (69)
Alder *Phytophthora*	23.7	78.3	0	55.6	20.6	75.4
Phytophthora spp.	1.7	0	0	0	1.5	0
Armillaria spp.	1.7	5.0	66.7	33.3	10.3	8.7
Cryptosporiopsis spp.	39.0	18.3	44.4	0	38.2	15.9
Phoma spp.	33.9	5.0	11.1	11.1	32.3	5.8
Cylindrocarpon spp.	6.8	3.3	22.2	11.1	8.8	4.3
Fusarium spp.	20.3	0	0	0	19.1	0

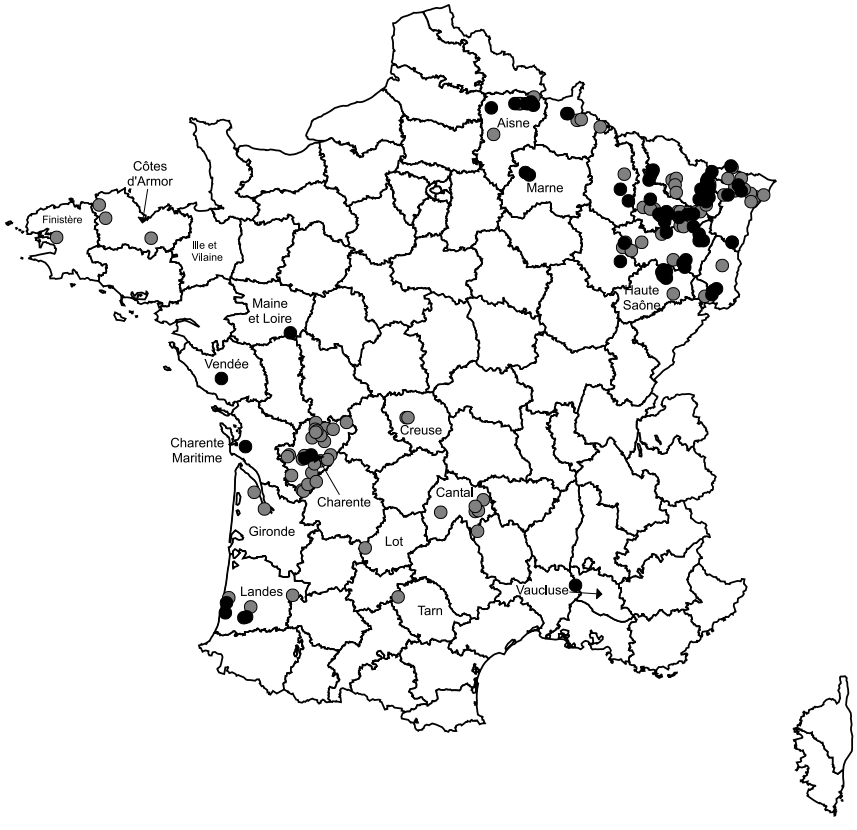

Fig. 2. Sites where alder declines were observed in France (1996–99). Black circles, alder *Phytophthora* isolated; grey circles, alder *Phytophthora* not isolated

4.1 Northern France (excluding north-eastern France described in section 3)

Damage is significant along the river Oise (Aisne department) and its main tributaries (DSF Nord-Ouest, 1997, unpublished data). A survey of alder populations on the upper reaches of the Oise was instituted for the purpose of river bank management (SCALLIEREZ 1997). A total of 152 plots of 100 trees were investigated. Alder dieback was reported in 62 plots, these were distributed right across the basin. Alder *Phytophthora* was isolated from several trees. Depending on the plot, between 20 and 68% of the trees were declining, with mortality reaching up to 6% (DSF Nord-Ouest, 1997, unpublished data).

Alder *Phytophthora* was isolated from two sites close together along the Marne river where 10–40% of the trees were declining. Only a few trees had died (DSF Nord-Est, 1997, unpublished data).

Damage is also serious in Haute-Saône (north-east of France) where alder *Phytophthora* was isolated at several places. A total of 2254 alders on four adjacent riparian sites were assessed in 1998; of which 77% were healthy, 20% were diseased and 3% were dead (DSF Nord-Est, 1998, unpublished data, and J.P. GRANDJEAN, personal communication). The trees are continuing to deteriorate. In one of the studied sites, 13% of the trees died between 1998 and 1999, and the number of healthy trees decreased from 33 to only 5% (J.P. GRANDJEAN, 1999, personal communication).

Table 3. **Alder declines in France between 1996 and 1999 (sources DSF)**

Date	Region	Name of the site	Site, name of the river	Other observations	Fungi isolated or possible causes
Northern and north-eastern France					
1997	Aisne	upper Oise valley	river bank, ru d'Haution and Ton		alder *Phytophthora*
	Marne	Damery	river bank, Marne		alder *Phytophthora*
		Epernay	river bank, Marne		alder *Phytophthora*
	Haute-Saône	Francalmont	river bank		*Armillaria*, Cerambycids, *Cryptosporiopsis*
		Breuche-les-Luxeuil	river bank, Combeauté		*Cryptosporiopsis*
	Vosges	Blévaincourt	alluvial plain		*Cryptosporium vulgare*, *Cryptosporiopsis*, *Armillaria*
	Bas-Rhin	Stattmatten	river bank, Moder		*Phoma*
		Weyersheim	river bank, Zorn		no pathogenic fungi isolated
		Bischwiller	river bank, Moder		no pathogenic fungi isolated
		Haguenau	river bank, Moder		*Fusarium*, *Cryptosporiopsis*
		Niedermodern	river bank, Moder		alder *Phytophthora*, *Cryptosporiopsis*, *Fusarium*, *Phoma*
		Metzviller	river bank, Zintsel du Nord		*Fusarium*
		Zinviller	swamp, Zintsel du Nord		alder *Phytophthora*, *Armillaria mellea*
		Dambach	river bank, Schwartzbach		no pathogenic fungi isolated
		Rothbach	river bank, Rothbach		*Stereum subtomentosum*, *Inonotus radiatus*, *Fusarium*, *Phomopsis*
		Niedersoultzbach	river bank, Soultzbach		no pathogenic fungi isolated
1998	Haute-Saône	Saint-Loup-sur-Semouse	river bank, Combeauté		alder *Phytophthora*; *Agelastica alni* (Chrysomelidae)
			pool of Roupoi		alder *Phytophthora*, *Cylindrocarpon*, *Phomopsis*, Basidiomycete

Table 3. **Continued**

Date	Region	Name of the site	Site, name of the river	Other observations	Fungi isolated or possible causes
	Haute-Saône	Francalmont	forest stand subject to flooding	cf first observation 1997	alder *Phytophthora*, *Armillaria?*
		Ormoiche	river bank, Combeauté		alder *Phytophthora*
		Breuche-les-Luxeuil	river bank, Combeauté	cf first observation 1997	*Cryptosporiopsis*, Basidiomycete
		Magnoncourt	grassland subject to flooding		alder *Phytophthora*
		Corbenay	grassland		alder *Phytophthora*
	Bas-Rhin	Sélestat	alluvial plain	cf first observation 1995	alder *Phytophthora*
1999	Haute-Saône	Ainvelle	forest stand subject to flooding	typical symptoms of alder *Phytophthora*	*Cryptosporiopsis*
Western France					
1996	Côtes-d'Armor	Ploumilliau	river bank		*Cladosporium*, *Pythium*
		Loc Envel	river bank		*Pythium*
1997	Charente	Taizé-Aizie	river bank, Charente		*Verticillium?*
		Verteuil	river bank, Charente		*Cryptosporiopsis*, *Phoma*
1998	Maine-et-Loire	Vaudelnay	river bank, Thouet		alder *Phytophthora*; *Agelastica alni* (Chrysomelidae)
1999	Charente	Gond Pontouvre	river bank, Charente	first observation 1997	alder *Phytophthora*
		Versac	river bank, Charente	first observation 1997	alder *Phytophthora*
South-western France					
1996, 1997	Landes	Léon and Vielle-Saint-Girons	lake bank, Léon		alder *Phytophthora*
		Soustons	lake bank, Soustons		alder *Phytophthora*, *Armillaria*
1997	Gironde	Cissac-Médoc	Valley bottom, Jalle du Beuil		no pathogenic fungi isolated
	Lot	Thèze valley	river bank, Thèze		*Cryptosporiopsis*, *Fusarium*, *Graphium*, *Armillaria*
1998	Gironde	Labarde	swamp		*Phytophthora* sp. (not alder P)
	Tarn	Puycelci	river bank, Testounet		*Cylindrocarpon*, *Inonotus radiatus*
	Landes	Lacquy	river bank		*Cryptosporiopsis*, *Armillaria*

Table 3. **Continued**

Date	Region	Name of the site	Site, name of the river	Other observations	Fungi isolated or possible causes
	Landes	Betbezer- d'Armagnac	Valley bottom		no pathogenic fungi isolated
		Hinx	alluvial plain		alder *Phytophthora*, *Cryptosporiopsis*
		Yzosse	river bank, Pédouille		alder *Phytophthora*
		Lesgor	river bank, Luzon		*Cryptosporiopsis*
Massif Central					
1997	Cantal	Saint-Urcize	river bank, Bès	mortality of old trees	age of the trees, high elevation, severe droughts
1998	Cantal	Jussac	river bank, Authre	progressive dieback	hail injury
		Saint-Flour	river bank, Ander		*Cryptosporiopsis*
	Creuse	Saint-Victor	swamp	dieback	intensive thinning, frost cracks (trunk), *Cryptosporiopsis*, insect defoliation
		La-Chapelle-Taillefert	agricultural land	young plantation	sunlight injury causing bark necrosis; no pathogenic fungi isolated
1999	Cantal	Villedieu	river bank	construction of a road	soil compaction, modification of the water course
		Les Ternes	river bank, Ternes	typical symptoms of alder *Phytophthora*	no pathogenic fungi isolated
		Vieillespesse	river bank, Arcueil	typical symptoms of alder *Phytophthora*	no pathogenic fungi isolated

4.2 Western France

In 1995, riparian managers reported alder dieback along several rivers of the Côtes d'Armor (Bretagne). Two sites were investigated in 1996. Most of the trees were diseased and some of them had died. They showed crown symptoms but no tarry spots on the trunk. Only *Pythium* sp. was isolated from roots (DSF Nord-Ouest, 1996, unpublished data).

Alder *Phytophthora* has been detected in four other administrative departments in the west of France: Maine-et-Loire, Vendée, Charente and Charente-Maritime.

In Maine-et-Loire, alder dieback was first detected in 1995. The number of diseased trees increased significantly in 1996 with typical symptoms of Phytophthora disease being present. All age classes were affected including 2-year-old-stems. The river valley of the Thouet is especially affected. At the site from which the alder *Phytophthora* was isolated 11% of the trees were dead and only 43% healthy (DSF Nord-Ouest, 1998, unpublished data).

In Charente, the death of alder has been occurring for a number of years and appears to have increased markedly after 1992–93. The alder *Phytophthora* has been isolated from two sites (C. ROBIN, personal communication and DSF Nord-Ouest, 1999, unpublished data). In 1997, alder decline represented 47% of the health problems concerning trees along the River Charente and its tributaries. Crown symptoms were typical of Phytophthora disease, but tarry spots were very rare. Thus tarry spots were only observed in 44 out of 1560 observed trees (DSF Nord-Ouest, 1997, unpublished data). In 1998, 26 monitoring plots, each of 60 trees, were established along local rivers. In all, 40% of the stems showed serious dieback and 1% was dead. Plots along the River Charente itself showed the highest incidence of disease. It was recorded that the severity of damage was related to the distance between the water level and that of the root collar: the nearer to the water level that the trees were, the greater was the degree of damage (DSF Nord-Ouest, 1998, unpublished data). Little change was noted in the disease between 1998 and 1999 when 66% of the stems showed no change, 18% showed a deterioration and 16% an improvement (DSF Nord-Ouest, 1999, unpublished data).

4.3 South-western France

As reported above, dieback was first observed on the banks of Lake Léon (Landes) as early as 1991. Other sites, and especially lakes along the Atlantic coast were also affected (DSF Sud-Ouest, 1997 and 1998, unpublished data).

It is clear that dieback has been occurring for several years along some of the Lot tributaries (Lot); the Thèze and the Masse valleys are the most affected. From 10% up to nearly 100% of the trees could be diseased with those furthest away from the water's edge being the least affected. Several sites were visited (DSF, Sud-Ouest, 1997, unpublished data) and the symptoms were typical of Phytophthora disease (crown symptoms and tarry spots). As yet, however, despite isolation attempts the alder *Phytophthora* has not been isolated.

Alder dieback has also be noted in Puycelci (Tarn), where 15–20% of the 25-year-old-trees and 5–10% of young coppice growth was diseased. Symptoms again were typical but the alder *Phytophthora* has not yet been isolated, despite attempts (DSF sud-Ouest, 1998, unpublished data).

4.4 Massif Central

Some alder decline has been recorded in two departments: Creuse and Cantal. Typical crown symptoms and tarry spots have been observed at two sites in the Cantal, but no likely pathogen has been isolated (LEGRAND, 1999, unpublished data). Other cases of alder

decline recorded in the Massif Central are caused by abiotic factors such as drought, changes in ground-water level, frost cracks on the trunk, hail injury to twigs or sunlight injury causing bark necrosis. In woodlands, some silvicultural factors are involved, such as suppression in under-thinned stands and exposure in over-thinned ones. Exposure can lead to crown dieback, although the trees usually remain alive and produce epicormic growth on the lower part of the stem (LEGRAND, 1997, 1998, 1999, unpublished data).

4.5 South-eastern France

Alder *Phytophthora* has been isolated at one site along the River Rhône near Avignon (Vaucluse) (Compagnie Nationale du Rhône and Lnpv, 1999, unpublished data).

5 Discussion and conclusion

Before 1990, no generalized dieback of alder associated with a *Phytophthora* in France was reported. The first mortality was observed at the beginning of the 1990s, but the alder *Phytophthora* was not isolated in France until 1996, when it was obtained simultaneously in Landes and in Lorraine. The alder *Phytophthora* is now known to be widespread in the country. It was isolated from trees with typical symptoms as described by GIBBS (1995) at nearly all the sites where dieback is severe. Isolation is sometimes difficult and attempts over several years have been necessary in order to succeed.

Damage is particularly significant in north-eastern and western France. However, the number of diseased or dead trees varies greatly from site to site; thus in 1999 it ranged from less than 5% at Liverdun (near Nancy) where the *Phytophthora* was isolated from trees and water (STREITO et al. 1999) to nearly 65% at Saint-Bernard (Alsace). The first results from the monitoring plots established in 1998 in the Rhin-Meuse basin seem to show that the disease is able to increase quickly. For example, between 1998 and 1999 the severity of crown symptoms increased in more than 30% of the trees at Niedermodern (Alsace), and the annual incidence of the disease (GIBBS et al. 1999) reached 14% for this site.

Those responsible for river bank management typically use alders as the main species for planting, and are now not clear what action to take. Considering the nature of the host and of the pathogen, a sanitation approach to control is not considered to be feasible. Experiments have been established in the United Kingdom and in France to determine whether there are any benefits to be gained from the early coppicing of diseased trees. Furthermore, in the United Kingdom, a range of European alder provenances is being evaluated to determine if differences in disease resistance are present (J. GIBBS, personal communication). However, no 'tried and tested' technique can be proposed for disease management or control at present.

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Résumé

Le Phytophthora de l'aulne en France: résultat des prospections réalisées entre 1995 et 1999

D'importants dépérissements d'aulne glutineux associés à un *Phytophthora* appelé le *Phytophthora* de l'aulne ont été signalés pour la première fois en Angleterre en 1993. En France, aucun dépérissement

généralisé n'avait été signalé avant 1990; les premières mortalités importantes d'aulne ont été observées dans les années 90, mais le *Phytophthora* de l'aulne n'a été isolé qu'en 1996. Tout d'abord, une synthèse des données sur les dépérissements d'aulne connus avant 1995 est présentée. Par la suite, une campagne de prospection a été organisée dans le Nord-Est de la France afin de connaître la répartition des dépérissements d'aulne. 108 sites de dépérissement ont été identifiés, et le *Phytophthora* de l'aulne a été isolé sur 57 d'entre eux. Les principaux cours d'eau sont contaminés, et les dégâts sont parfois considérables. La fréquence du *Phytophthora* de l'aulne et des autres champignons obtenus par isolement à partir d'aulnes dépérissants est discutée. Enfin, les principaux dépérissements d'aulne glutineux observés en France depuis 1995 sont passés en revue région par région, et une carte synthétise l'état actuel des connaissances. Le *Phytophthora* de l'aulne apparaît fréquent et largement répandu en France; la plupart des dépérissements ont été signalés sur la façade atlantique et dans le Nord-Est, mais les dégâts sont très variables d'un site à l'autre.

Zusammenfassung

Die Phytophthora-Erkrankung der Schwarzerle (Alnus glutinosa) in Frankreich: Untersuchungen zwischen 1995 und 1999

Ein erheblicher Befall von Schwarzerlen mit einer neuen *Phytophthora*-Art ('Erlen – *Phytophthora*') wurde 1993 erstmals in England beschrieben. Aus Frankreich lagen vor 1990 keine Berichte über ein Erlensterben vor. Erste deutliche Symptome und Absterbeerscheinungen an Schwarzerlen wurden hier zu Beginn der Neunzigerjahre beobachtet, aber die sogenannte 'Erlen-*Phytophthora*' wurde in Frankreich erst 1996 isoliert. Der Artikel präsentiert einleitend eine Zusammenfassung der in Frankreich vor 1995 beobachteten Fälle des Erlensterbens. Anschliessend wird eine Inventur in Nordostfrankreich dargestellt, die 108 Standorte umfasste. Die 'Erlen-*Phytophthora*' wurde an 57 Standorten isoliert. Alle grösseren Flüsse waren betroffen und die Schäden waren teilweise beträchtlich. Die Häufigkeit, mit der die 'Erlen-*Phytophthora*' und andere Pilze aus den erkrankten Erlen isoliert wurden, wird diskutiert. Abschliessend wird die Verbreitung des Erlensterbens seit 1995 in Frankreich, geordnet nach Regionen, vorgestellt und in einer Karte zusammengefasst. Die 'Erlen-*Phytophthora*' scheint in Frankreich häufig und weit verbreitet zu sein; West- und Nordostfrankreich sind besonders stark betroffen. Jedoch variiert die Anzahl erkrankter und toter Bäume von Standort zu Standort erheblich. Alle Nachweise stammen von *Alnus glutinosa*, andere *Alnus*-Arten waren in den Beobachtungsflächen nur selten vorhanden.

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