SOME RECENT ISSUES REGARDING THE EUROPEAN BEECH DECLINE IN ROMANIA

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ABSTRACT

The dieback of European beech trees has occurred in the northeast of Romania since 2000, but beech decline has also been noticed in other regions. The disease factors have been recorded in 11 experimental plots (of which 6 permanent) and along different transects.

The most important decline factors seem to be the climatic conditions (drought of 1999-2000), stand characteristics (age, proportion of beech in stand composition), landform (especially plain sites), soil characteristics (excessive clay or sand content), associated (bark and wood) fungi and insects.

Key words: beech decline, insects, bark batles, associated fungi

INTRODUCTION

In Romania the "beech decline" was noticed in the same regions with silver fir decline in the 1980's (Barbu, 1991). Between 1980 and 1995 the beech problems have been considered as belonging to the "beech canker" and seldom to the "beech bark disease" (Chira et al., 1996, 1998). Decline symptoms, noticed in the central part of Romania in 1999-2000, seemed to be due to an outbreak of Phyllaphis fagi after heavy late frosts (Mihalciuc et al., 2001). Since 2000 the "beech decline" has especially occurred in the northeast of Romania, most of the symptoms being similar to the same phenomenon in the western part of Europe (Roloff, 1989, Nageleisen, 1993, 1994; Pilard-Landeau et al., 1994, Marcu et al., 1999).

METHOD

The beech decline was studied in the northeast of Romania (Forest Administration of Suceava - Forest Districts of Patrauti, Adâncata, Dolhasca, Marginea, and Falticeni). Abiotic and biotic factors involved as well as evolution of decline was recorded in 6 permanent experimental plots (50 trees/plot), 5 temporary ones and along different transects during the periodic inventories carried out in 2001 and 2002. The following cha

racteristics were registered: d.b.h, crown diameter, Kraft class, crown defoliation (transparency), degree of crown dying, branch dying, epicormic branching, stem bleeding, bark and wood insects, bark and sapwood/heartwood fungi, wet heartwood, wood discoloration and rot.

The influence of soil was also observed in 11 comparative plots. In each plot soil profiles were dug up both in damaged area and control points (healthier proximity to the same forests).

RESULTS

Location

The beech decline has been recorded in the hilly beech and sessile oak forests of the northeast of Romania since 2000.

Stand characteristics

Stand composition has been highly variable, from pure beech forests to different mixed beech stands with sessile oak, pedunculate oak, hornbeam, common ash, Norway maple, sycamore etc. Beech has had high productivity, ± even-aged structure, and normal density (0.7-0.8). Stand age has been old (109 yr. on average), with the exception of 3 cases (out of 57) of 42-57 yr. and 5 of 82-97 yr.

Climate conditions

In the last 40 years Suceava Meteorological Station has registered several critical periods for beech, when the de Martonne (aridity) index had lowered below the limit of forest (AI = 30) or forest steppe (AI = 25): 19.7 in 1986, 24.5 in 1990, and 21.7 in 2000. The last dry period (1999-2000) has differed from the other excessively arid ones (1986, 1989-1990) by the sunshine duration (significant longer in 2000 compared to 1990), aridity index of vegetation period (AI10 - much lower in 1999 compared to 1989), less favourable conditions in the following year after drought (2001 compared to 1991), and late frosts in 1999 and 2000 (table 1).

Soil and other site characteristics

In 7 cases (out of 12 studied) the site potential for beech is average-minimum or even minimum (rainfall), in 4 cases it is average and only one factor (temperature) provides optimum conditions for beech (Stanescu et al., 1997).

Table 1. Climatic data of the Meteorological Station of Suceava

Year	T		Hr		R		SD		AI	AI10
	A	V	A	V	A	V	A	V	A	V
1	2	3	4	5	6	7	8	9	10	11
1961	**8.3**	16.2	78	73	503.1	317.7			**27.49**	48.50
1962	7.5	16.0	81	76	603.1	295.1			34.46	45.40
1963	7.3	**18.3**	**76**	**69**	**458.0**	**236.6**			**26.47**	**33.44**
1964	7.0	16.1	80	73	**455.1**	**262.5**			**26.77**	**40.23**
1965	6.7	15.6	85	84	577.6	363.4	1668.5	991.7	34.59	56.78
1966	**8.4**	15.9	83	79	705.3	467.0	1820.4	1172.3	38.33	72.12
1967	8.2	**16.7**	78	74	582.7	406.7	**2139.7**	**1273.6**	32.02	60.93
1968	8.0	16.3	78	**72**	671.1	471.3	1900.8	1088.4	37.28	71.68
1969	6.4	16.0	81	77	707.5	485.2	1863.2	1126.6	43.14	74.65
1970	7.6	15.8	79	73	612.1	354.6	1988.2	**1262.0**	34.78	54.98
1971	7.6	15.5	79	76	624.7	440.3		1097.3	35.49	69.07
1972	7.6	16.1	81	77	689.8	498.8	1733.9	1043.4	39.19	76.44
1973	7.6	15.9	80	81	**463.8**	333.4	**2052.6**	1132.4	**26.35**	51.49
1974	7.7	15.4	80	76	**833**.4	**668**.9	1796.7	1012.4	47.08	**105.34**
1975	**8.7**	**17.0**	77	75	608.6	383.2	1967.0	**1208.0**	32.55	56.77
1976	6.4	**14.4**	78	74	618.7	373.3	1883.8	1135.2	37.73	61.20
1977	7.6	15.0	81	81	591.6	415.7		1061.5	33.61	66.51
1978	6.7	**14.3**	86	84	782.9	552.7	1801.7	1043.0	46.88	90.98
1979	7.7	16.5	78	**72**	629.4	401.9	1821.3	1116.7	35.56	60.66
1980	6.3	14.7	82	76	603.9	363.1	1618.7	947.5	37.05	58.80
1981	7.3	15.8	82	81	804.0	542.9	1752.3	1093.1	46.47	84.17
1982	7.7	**16.7**	82	80	502.3	297.0	**2018.4**	**1235.1**	**28.38**	44.49
1983	**8.5**	16.3	**76**	76	**496.3**	379.1	**2051.1**	1169.9	**26.83**	57.66
1984	7.2	15.2	82	76	675.4	416.9	1681.4	1087.0	39.27	66.17
1985	6.3	15.9	85	79	641.8	446.7	1883.6	1168.3	39.37	68.99
1986	7.7	**16.8**	81	75	**348.2**	**204.5**	1999.9	**1244.4**	**19.67**	**30.52**
1987	6.5	16.3	80	74	579.5	**270.9**	1697.9	1090.1	35.12	**41.20**
1988	7.5	16.6	77	**72**	735.7	437.7	1664.4	**909**.5	42.04	65.82
1989	**9.2**	15.7	**68**	**65**	520.2	359.9	1975.1	1081.3	**27.09**	56.02
1990	**9.4**	16.2	**65**	**61**	**420.9**	**224.3**	**2045.4**	1163.5	**21.70**	**34.24**
1991	7.7	15.8	**76**	75	771.4	**609**.6		**903**.2	43.58	**94.51**
1992	**8.3**	16.6	**75**	74	545.3	370.1	1877.1	1167.9	**29.80**	55.65
1993	7.5	15.9	**76**	74	570.8	**288.7**			32.62	44.59
1994	**9.2**	**17.6**	80	76	**470.7**	**278.9**	1983.7	**1231.6**	**24.52**	**40.42**
1995	8.1	16.7			543.4	316.5			30.02	47.42
1996	6.7	16.2	80	**71**	642.9	392.8	1635.1	1037.2	38.50	59.97
1997	7.4	16.1	**76**	73	591.0	414.0	1902.0	1051.1	33.97	63.45
1998	8.0	16.4	82	82	741.7	469.3	1811.3	991.1	41.21	71.11
1999	**8.9**	**17.4**	80	77	514.7	**258.3**	**2022.2**	**1212.3**	**27.23**	**37.71**
2000	**9.3**	16.7	81	75	**418.3**	**280.5**	**2262.2**	**1343.6**	**21.67**	**42.02**
2001	**8.4**	**16.8**	80	74	688.6	437.2	1987.0	1121.7	37.42	65.25
Av	**7,7**	**16,1**	**79,1**	**75,3**	**598.7**	**385.1**	**1884.6**	**1114.7**	**33.98**	59.20
Sd	**0,8**	**0,8**	**3,9**	**4,5**	**112.8**	**103.8**	**156.5**	**103.0**	**7.05**	16.81

T: annual temperature (^{0}C); **Hr**: annual relative humidity (%); **R**: annual rainfall (mm); **SD**: annual sunshine duration (hours), **A:** annual; **V:** during the vegetation period (V-IX); **AI**: de Martonne (aridity) index; **AI10**: aridity index during the vegetation period, **Av**: overall average; **Sd**: standard deviation

Table 2. Pedological characteristics in the area affected by beech decline.

a. Patrauti Forest District, IV, 10A (affected plot S.I) and 22D (control C.I)

S.I		Chemical charact.			**S.VIII**		Chemical charact.			**C.I**		Chemical charact.		
Depth (cm)	Horizon	pH (H_2O)	Ht (%)	Ca CO_3 (%)	Depth (cm)	Horizon	pH (H_2O)	Ht (%)	Ca CO_3 (%)	Depth (cm)	Horizon	pH (H_2O)	Ht (%)	Ca CO_3 (%)
0-2(3)	Ao	**4.45**	5.71	-	0-11	Ao	**3.96**	**2,94**	-	0-3 (4)	Ao	**4.37**	5.65	-
2(3)-20	Ea_1w	**4.38**	1.80	-	11-24	Ea	**4.17**	0.88	-	3(4)-25	Ea_1w	**4.23**	1.46	-
20-40	Ea_2w	**4.46**	1.09	-	**24-38**	**EB.w**	**4.24**	0.68	-	25-45	Ea_2w	**4.48**		-
40-60	**Bt_1w**	4.67	0.73	-	38-74	Bt_1w	4.**51**	0.8**3**	-	**45-60**	**EB.w**	4.61	0.96	-
60-80	Bt_2w(W	4.82		-	74+	Bt_2w(W	**4,76**		-	**60**-80	Bt_1w	4.86	**1.47**	-
80-100	Bt_3w(W	5.01		-						80-100	Bt_2w	5.09	**0.89**	-
100-120	Bt_4w(W	**5.46**		-						100-120	Bt_3w	5.27		-

S.I – Physical characteristics							**S.VIII** – Physical charact.							**C.I** – Physical characteristics						
Sc %g	Sf %g	St %g	Cf %g	Cc %g	Idt	T	Sc %g	Sf %g	St %g	Cf %g	Cc %g	Idt	T	Sc %g	Sf %g	St %g	Cf %g	Cc %g	Idt	T
2.85	41.99	31.59	42.56	23.56		LL	2.75	46.45	30.29	37.27	20.51		SMLL							
1.81	40.43	29.04	**45.03**	**28.71**		LL	2.09	43.06	29.20	41.49	25.65	1.25	LL	**3.71**	40.98	29.74	42.69	25.57		LL
							1.62	35.73	26.36	**51.96**	**36.29**	1.77	TT	**2.86**	33.70	29.41	50.16	34.02	1.33	˘
1.02	36.88	22.77	52.54	39.32	**1.67**	˘	1.17	36.09	23.35	53.22	39.39	1.92	TT	**2.53**	29.31	28.22	**55.11**	39.94	1.56	˘
1.73	31.73	26.09	**55.6**	**40.4**	**1.72**	˘								**4.38**	37.03	21.14	50.11	**37.44**	1.46	˘

Sc: coarse sand; Sf: fine sand; St: total silt; Cf: physical clay; Cc: colloidal clay; Idt: textural differentiation index; T: texture symbol: SM: medium sandy loam; LL: medium loam; TT: medium clayey loam

b. Patrauti F.D., IV, 9A (affected plot S.II and control C.II)

S.II		Chemical characteristics			**C.II**		Chemical characteristics		
Depth (cm)	Horizon	pH (H_2O)	Ht (%)	$CaCO_3$ (%)	Depth (cm)	Horizon	pH (H_2O)	Ht (%)	$CaCO_3$ (%)
0-2(3)	Ao	**4.37**	**5.20**	-	0-3 (4)	Ao	4.69	3.81	-
2(3)-20	Ea	**4.40**	1.65	-	3(4)-20	El(Ea)	4.53	1.64	-
20-40	EB.**w**			-	20-50	EB	4.58	0.89	-
40-60	Bt_1w	4.54	0.72	-	50-70	Bt_1(w)	4.77	0.62	-
60-80	Bt_2w(W			-	70-90	Bt_2w	4.81		-
80-100	Bt_3w(W	4.70		-	90-100	Bt_3w	4.81		-
100-120	**Bt_4w**				100-120	**BCw**	4.95		-

S.II	Physical characteristics							**C.II**	Physical characteristics						
Depth (cm)	Hori-zon	Sc %g	Sf %g	St %g	Cf %g	Cc %g	Idt	T	Depth (cm)	Hori-zon	Sc %g	Sf %g	St %g	Cf %g	Cc %g	Idt	T
0-2(3)	Ao								0-3 (4)	Ao							
2(3)-20	Ea	5.97	42.75	30.34	36.60	20.94		LL	3(4)-20	El(Ea)	**20.1**	32.15	26.51	34.59	21.23		LL
20-40	EB.**w**								20-50	EB							
40-60	Bt_1w	3.81	34.37	24.79	**2.2**	**7.0**	**1.77**	˘	50-70	Bt_1(w)	**19.8**	26.28	20.33	44.70	33.55	1.58	˘
60-80	Bt_2w(W								70-90	Bt_2w	**15.7**	27.59	19.72	48.74	36.91	1.74	˘
80-100	Bt_3w(W	3.04	34.56	22.85	**3.0**	**9.5**	**1.89**	˘	90-100	Bt_3w							
100-120	**Bt_4w**								100-120	**BCw**	**3.**	**8.71**	11.29	**32.9**	**6.4**	1.25	LN

Sc: coarse sand; Sf: fine sand; St: total silt; Cf: physical clay; Cc: colloidal clay; Idt: textural differentiation index; T: texture symbol: LN: sandy clayey loam; LL: medium loam; TT: medium clayey loam

c. Patrauti F.D., IV, 26A (affected plot S.III) and 25A (control C.III)

S.III		Chemical characteristics			**C.III**		Chemical characteristics		
Depth (cm)	Horizon	pH (H_2O)	Ht (%)	$CaCO_3$ (%)	Depth (cm)	Horizon	pH (H_2O)	Ht (%)	$CaCO_3$ (%)
0-2(3)	Ao	**3.70**	4.64	-	0-3	Ao	**4.15**	4.80	-
2(3)-23	**Ea_1**	**4.14**	1.62	-	3-20	**AE**	**4.15**	1.95	-
23-40	**Ea_2**	4.38		-	20-40	**El_1**	4.47		-
40-53	**$EB_1(w)$**	4.55	0.69	-	40-67	**$El_2(w)$**	4.70	0.76	-
53-67	**EB_2w**	4.64		-					
67-87	**Bt_1w**	4.81	0.74	-	67-80	**EB.w**	4.74	0.60	-
87-100	Bt_2w	4.90		-	**80**-90	Bt_1w	4.76		-
					90-105	Bt_2w	4.76		-
100-120	Bt_3w	5.07		-	105-120	Bt_3w	4.81		-

S.III		Physical characteristics							**C.III**		Physical characteristics						
Depth (cm)	Hori-zon	Sc %g	Sf %g	St %g	Cf %g	Cc %g	Idt	T	Depth (cm)	Hori-zon	Sc %g	Sf %g	St %g	Cf %g	Cc %g	Idt	T
0-2(3)	Ao								0-3	Ao							
2(3)-23	**Ea_1**	2.11	50.68	27.77	**34.79**	**19.45**		SF	3-20	**AE**	**10.76**	47.14	25.95	29.93	16.15		SM
23-40	**Ea_2**								20-40	**El_1**							
40-53	**$EB_1(w)$**	1.87	43.53	23.71	**3.8**	**0.8**	1.59	LL	40-67	**$El_2(w)$**	**8.11**	48.39	22.77	33.08	20.73		LL/SM
53-67	**EB_2w**																
67-87	**Bt_1w**	1.30	40.50	21.05	**9.4**	**7.1**	**1.91**	T	67-80	**EBw**	**9.82**	50.37	14.89	32.04	24.92	1.35	LN
87-100	Bt_2w								**80**-90	Bt_1w	**11.49**	55.51	10.14	27.61	22.86	1.24	LN
									90-105	Bt_2w	**13.49**	47.22	13.27	33.13	26.01	1.41	LN
100-120	Bt_3w	2.39	33.83	25.71	**2.7**	**8.0**	1.96	T	105-120	Bt_3w							

Sc: coarse sand; Sf: fine sand; St: silt; Cf: physical clay; Cc: colloidal clay; Idt: textural differentiation index; T: texture: SF: fine sandy loam; SM: medium sandy loam; LN: sandy clayey loam; LL: medium loam; TT: medium clayey loam

d. Adâncata F.D., VI, 16B (affected plots S.V.2 and control C.V.4)

S.V.1		Chemical characteristics			**C.V.4**		Chemical characteristics		
Depth (cm)	Horizon	pH (H_2O)	Ht (%)	$CaCO_3$ (%)	Depth (cm)	Horizon	pH (H_2O)	Ht (%)	$CaCO_3$ (%)
0-4(5)	Ao	**4.50**	5.01	-	0-5	Ao	4.75	4.26	-
4(5)-25	AE(**w**)	4.47	3.01	-	5-20	AE	4.38	1.97	-
25-40	El**w**(EBv	4.72	1.49	-	20-40	El	4.61	1.27	-
40-80	Btw	4.76	1.04	-	40-50	**$EB_1(w)$**	4.86		-
					50-70	**EB_2w**	4.98	1.14	-
80-100	**BCw**	**7.04**		**0.3**	70-110	Btw	5.00		-

S.V.1		Physical characteristics							**C.V.4**		Physical characteristics						
Depth (cm)	Horizon	Sc %g	Sf %g	St %g	Cf %g	Cc %g	Idt	T	Depth (cm)	Horizon	Sc %g	Sf %g	St %g	Cf %g	Cc %g	Idt	T
0-4(5)	Ao								0-5	Ao							
4(5)-25	AE(w)	3.82	32.94	36.61	**48.04**	**26.63**		LP	3(4)-20	AE	0.64	42.84	32.14	41.65	24.38		LL
25-40	Elw (EBw)	5.15	29.69	34.34	**49.42**	**30.82**		LP	5-20	AE	3.41	49.63	28.74	32.54	**18.22**		SM
									20-40	El	4.71	50.32	28.21	30.80	**16.75**		SM
40-80	Btw	1.51	21.81	26.06	**4.5**	**0.6**	1.90	T	50-70	EB_2w	1.66	38.30	34.16	45.14	**25.89**	1.54	LP
80-100	BCw	0.60	20.96	28.12	**3.6**	**0.3**	1.89	T	70-110	Btw	0.70	30.58	29.31	**55.84**	**39.41**	2.35	TT

Sc: coarse sand; Sf: fine sand; St: total silt; Cf: physical clay; Cc: colloidal clay; Idt: textural differentiation index; T: texture: SM: medium sandy loam; LL: medium loam; LP: silty loam; TT: medium clayey loam; AL: loamy clay

e. Dolhasca F.D., V, 36A (affected plots S.VII and control C.VII)

S.VII		Chemical characteristics			**C.VII**	
Depth (cm)	Horizon	pH (H_2O)	Ht (%)	$CaCO_3$	Depth (cm)	Horizon
0-3	Ao	5.74	4.27	-	0-4	Ao(Aom)
3-17	AE	5.15	2.99	-	4-20	AE
17-32	EB.w	5.51	2.55	-	20-55	EB.w
32-60	**Btw**	6.45	1.52	-		
60-70	**BCw**				55-85	**Bt_1w**
70-80	**C_1w**	7.36		**11.0**		
80-100	**C_2w**	7.65		**16.3**	>85	**Bt_2w**

S.VII		Physical characteristics							**C.VII**	
Depth (cm)	Horizon	Sc %g	Sf %g	St %g	Cf %g	Cc %g	Idt	T	Depth (cm)	Horizon
0-3	Ao								0-4	Ao(Aom)
3-17	AE	0.61	23.62	38.05	**60.75**	**37.71**		**TP**	4-20	AE
17-32	EB.w	0.66	22.59	36.52	**62.81**	**40.23**		**TP**	20-55	EB.w
32-60	**Btw**	0.16	14.55	30.48	**74.83**	**54.81**	1.45	**AL**		
60-70	**BCw**								55-85	**Bt_1w**
70-80	**C_1w**	0.27	14.42	33.44	**75.09**	**51.87**	1.37	**AP**		
80-100	**C_2w**								>85	**Bt_2w**

Sc: coarse sand; Sf: fine sand; St: total silt; Cf: physical clay; Cc: colloidal clay; Idt: textural differentiation index; T: texture symbol: TP: clayey-silty loam; AL: loamy clay; AP: silty clay

f. Dolhasca F.D., I, 49D (affected plot S.VI) and 49A, C (control C.VI)

S.VI		Chemical characteristics			**C.VI**	
Depth (cm)	Horizon	pH (H_2O)	Ht (%)	$CaCO_3$ (%)	Depth (cm)	Horizon
0-5(6)	Ao	6.11	3.28	-	0-3(4)	Ao
5(6)-27	**AB.w**(AE**w**)	5.88	1.52	-	3(4)-20	AE
27-45	**Btw**	6.80	1.02	-	20-37	El
					37-45	EB.w
45-60	**C_1w**	7.58	0.59	**11.5**	**45**-60	Bt_1w
60-90	**C_2w**	7.83		**6.1**	60-80	Bt_2w
90-120	**C_3w**	7.87		**6.7**	80-100	Bt_3w

S.VI		Physical characteristics							**C.VI**	
Depth (cm)	Horizon	Sc %g	Sf %g	St %g	Cf %g	Cc %g	Idt	T	Depth (cm)	Horizon
0-5(6)	Ao								0-3(4)	Ao
5(6)-27	**AB.w** (AE**w**)	0.24	57.13	21.37	33.41	21.26		LL/LN	3(4)-20	AE
27-45	**Btw**	0.22	51.07	17.12	42.24	31.60	1,48	LL	20-37	El
									37-45	EBw
45-60	**C_1w**	0.45	44.28	22.28	47.39	32.99		TT/LL	**45**-60	Bt_1w
60-90	**C_2w**	0.21	**81.92**	8.43	15.18	9.44		UF	60-80	Bt_2w
90-120	**C_3w**	1.74	**69.75**	13.63	22.72	14.88		SF	80-100	Bt_3w

Sc: coarse sand; Sf: fine sand; St: total silt; Cf: physical clay; Cc: colloidal clay; Idt: textural differentiation index; T: texture symbol: UF: fine loamy sand; SF: fine sandy loam; LN: sandy clayey loam; LL: medium loam; LP: silty loam; TT: medium clayey loam; TP: clayey-silty loam; AL: loamy clay; AP: silty clay

In terms of aspect, the majority of beech stands affected by decline are south facing, south-east or southwest facing, that is not typical for beech in the Romanian hilly pure and mixed beech forests.

Beech decline has especially occurred on relatively flat sites (plateau, low and long slopes, foot slopes, narrow steps on slope), with very low or practically no external drainage. In this first case soils have a clayey loam or clay (seldom loam or silty loam) Btw horizon, at 35-40 cm, seldom at 65-70 cm depth (table 2 a-d).

Sometimes such phenomenon has been found on higher slopes (10-150), with better external drainage, but also showing a clayey Btw horizon at 35-40 cm depth (table 2 e).

The clayey texture of soil has determined a low internal drainage and lead to the stagnation of rainfall water above/within Btw horizon and pseudo-gleyzation. Both processes have occurred even in soils with a lower clay content (31-32%) in Btw horizon, but with an average to high content of coarse sand (10-17% to 20-30%), proving the existence of a clayey deeper ground material (Patrauti F.D., working circle V, subcompartment 3B). These soils have been characterised by very large amplitude of humidity and generally present an unfavourable alternation of excessive humidity/aeration deficit with humidity deficit/relative normal aeration.

Morphologic and textural characteristics of the soils in the control points (lower content of clay in Btw and other horizons, deeper occurrence of Btw horizon or pseudo-gleyzation) represent more favourable soil characteristics for beech compared to the decline plots (table 2 a-e).

High to very high soil acidification with a maximum in the first 40-50 cm was measured in Patrauti and Adâncata F.D. (table 2 a-d). Data reflect an unusual situation in the first 2-3 horizons with atypical variation, probably of artificial origin (owing to local pollution).

In the second case (Dolhasca, I, 49 table 2 f) the beech decline has occurred on a slope higher than 150 but only on a strip with carbonated sand deposit at 45-60 cm depth. Such fact determines a lower physiological available volume of soil and also a strong decrease of the water retention capacity. The control profiles have showed a more than 100 cm depth Btw horizon (table 2 f).

Associated fungi

Bark and sapwood fungi

Nectria coccinea (commonly associated with "beech bark disease") has been noticed on:logs left for a shorter or longer period of time in the forest after cutting (sometimes the infection intensity has been very high); stumps left after the sanitary cutting of dying trees; the frequency of this fungus has been very high only in few stands (Patrauti, IV, 27C) that could indicate old infections (before felling - on standing trees, which has not been recorded owing to the lack of perithecium); cankerous branches left on the humid forest floor after logging (low frequency - Patrauti, IV, 26A); standing dying trees (Patrauti, IV, 26-27); this infection seemed to have very low frequency at least according to the presence of perithecium.

Schizophyllum commune (associated with both "beech bark disease" and "beech decline") has occurred frequently on standing trees in some stands (Patrauti, V, 3B; Dolhasca, I, 49D), being located on the wounded roots or trunks (on bark damaged by sunstroke, cracks, or wounds).

Wood-destroying fungi

Ante-decline fungi - *Fomitopsis pinicola, Fomes fomentarius, Phellinus* spp., etc. - have been noticed on few standing trees or on logging slash (Patrauti, IV, 26-27). They have seldom produced strong infections of rotten bark and sapwood that easily fell down.

Post-decline fungi have seldom occurred on standing trees but more frequently on logs laying on the humid forest floor for several months. Strong coloration of sapwood and partially of heartwood at different stem heights (even up to the crown) on some standing trees with crown defoliation of 80-90% has been observed.

Among the wood-destroying fungi the most common - Coriolus hirsutus - has generally followed S. commune on standing trees (Dolhasca, I, 49D; Patrauti, V, 3B) or on logs. Oudemansiella mucida, Panellus spp., etc. have been seldom identified on standing trees (Patrauti) at variable heights (4-15 m) of beech stem, sometimes even on healthier trees (with crown defoliation below 50%).

Rhizomorphs of Armillaria gallica have been noticed in some cases of dead trees, but the influence of this fungus on beech decline has probably been rather small. Black-coloured roots (Xylariaceae ?) have also been observed in the clayey horizons of soil (Patrauti, IV, 27C).

Associated insects

Cryptococcus fagisuga (primary agent of "beech bark disease")

- Area: in all beech stands.

- Frequency/Intensity: variable. In the affected area the frequency on healthy stems has been very high in all stands, but its intensity has generally been very low (1) to low (2) as follows: 1.20 (individual maximum 2.5 - low to average) in affected plot S.II; 0.96 (max. 4 - high) in S.I; 1.06 (max. 2) in Patrauti IV 26A(I); 2.13 (max. 5 - very high) in S.III; 0.64 (max. 2) in Patrauti IV 27C; 1.20 (max. 3 - medium) in S.IV; 2.01 (max. 3) in S.V; 1.30 (max. 2) in S.VI, and 1.63 (max. 2) in S.VII.

- Favouring factors. The intensity of C. fagisuga has been correlated with the following factors: crown defoliation (*, ** in 4 out of 9 experimental plots), tree girth (*, ** in 3 plots), dying degree (*, ** in 2 plots), occurrence of dead branches (* in 2 plots), intensity of beech canker (*** in 1 plot), intensity of bark insects (** in 1 plot), occurrence of S. commune (* in 1 plot), and leaf coloration (* in 1 plot). The most frequent correlation - with tree girth and crown defoliation - could be important in relationship with "beech decline", even if the correlation is not strong and obvious as in the case of "beech bark disease".

Bark insects

The main characteristics of the attack of bark insects (different larvae of Agrillus spp., Cerambycidae, etc.) are the following:

Occurrence: identified in the spring of 2001. Area: recorded in many declined stands.

Frequency/Intensity: variable but general low (1). The average intensity of bark insects has been nearly nil (0 - 0.07) in S.I-III and Patrauti IV 27C, not significant (0.24) with 12% frequency in S.IV, very low (0.73) but 48% frequency, low (1.40-1.67) with 60-80% frequency, and moderate (1.94, but 42% of intensity) with 88% frequency.

Favouring factors. Bark insects intensity has been correlated with the following factors: crown defoliation (**, *** in 3 out of 9 experimental plots), dying degree (*** in 2 plots), intensity of C. fagisuga (*, ** in 2 plots), occurrence of dead branches (* in 2 plots), and canker intensity (** in 1 plot). The strongest correlation - with crown defoliation - is normal, the insects attacking the weakest trees.

Xylophagous insects

Xyleborus saxeseni

Occurrence: identified in the autumn of 2002. Area: recorded in Patrauti (IV-V).

Favouring conditions: very high intensity (10-20 beetles/sq.dm.) on recently dead old (about 100 yr.) trees, apparently unaffected by other factors; moderate intensity on old (about 100 yr.) trees located on the border of felled area (suffering by sunstroke but still relatively healthy - 40% crown defoliation).

Trypodendron domesticum

Occurrence: identified in the spring of 2003, but the symptoms have been previously noticed in 2002. Area: recorded in Patrauti (IV, 10A, 30A).

Favouring conditions: average to high intensity on recently fallen trees and on relatively fresh stumps; low intensity on the butt of standing trees (sometimes with 30% crown defoliation - Patrauti, IV, 30A).

The evolution of decline

The volume of dead and dying trees (Patrauti F.D.) has increased with 48% in 2002 compared to 2001. The intensity of sanitary cutting has varied from normal (<5cu.m. per ha) to high values (10.7-38.8 cu.m. per ha). Between the first (June 2001) and the last (September 2002) inventory in permanent plots the percentage of moderate-highly to highly affected trees has increased from 10-24% to 50-56%. Pedunculate and sessile oak as well as young hornbeam trees have been much more resistant to drought (Chira et al., 2003, in press).

CONCLUSIONS

European beech decline has occurred especially in the hilly zone of north-eastern Romania since 2000. The decline process has started in a polluted area under the dry

weather conditions of 1999-2000 following two years (1999 and 2000) of severe late frosts. The most sensitive stands have been the oldest (generally over 100 years old), located on plateau or nearly flat slopes with soils excessively rich of clay or sand. Associated bark (Nectria coccinea, Nectria ditissima, Schizophyllum commune) and wood (Coriolus hirsutus, Fomes fomentarius, Fomitopsis pinicola, Oudemansiella mucida, Phellinus spp., etc.) fungi have been noticed. Some bark insects (Cryptococcus fagisuga, Agrillus spp., Cerambicidae) have been correlated in several plots with crown defoliation. Wood insects (Xyleborus saxeseni, Trypodendron domesticum) have also been recorded.

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