New Phytologist

***New Phytologist* Supporting Information**

Article title: **Drought increases Norway spruce susceptibility to the Eurasian spruce bark beetle and its associated fungi**

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Table S8 (a) *Picea abies* study tree bark contents of total phenolics, Sol S, soluble sugars, starch, and NSC, non-structural carbohydrates. (b) Phloem contents of glucose, sucrose, fructose, and starch

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Fig. S1 Sequence of critical periods in the population dynamics of *Ips typographus* over space and time, from phases of low beetle abundance (endemic stage) to population build-up and outbreak stage. The dispersal phase on landscape scale is characterized by the search of bark beetles for suitable habitats, mainly guided by olfactory and visual cues that originate from host or non-host trees. During epidemic phase, mass aggregation in response to pheromones leads to a fast colonization of multiple Norway spruce (*Picea abies*) host trees. This study focuses on the decisive period before a mass outbreak, when few pioneer beetles land on the bark of potential hosts and pheromones are not yet the dominant drivers of attack. The defense response of selected trees to the first attacking beetles in combination with the beetles' positive or negative reaction to olfactory, gustatory, and possibly haptic cues eventually results in host acceptance or rejection and might be decisive for outbreak initiation. Here, we investigated the effect of drought stress on host defense and bark beetle response.

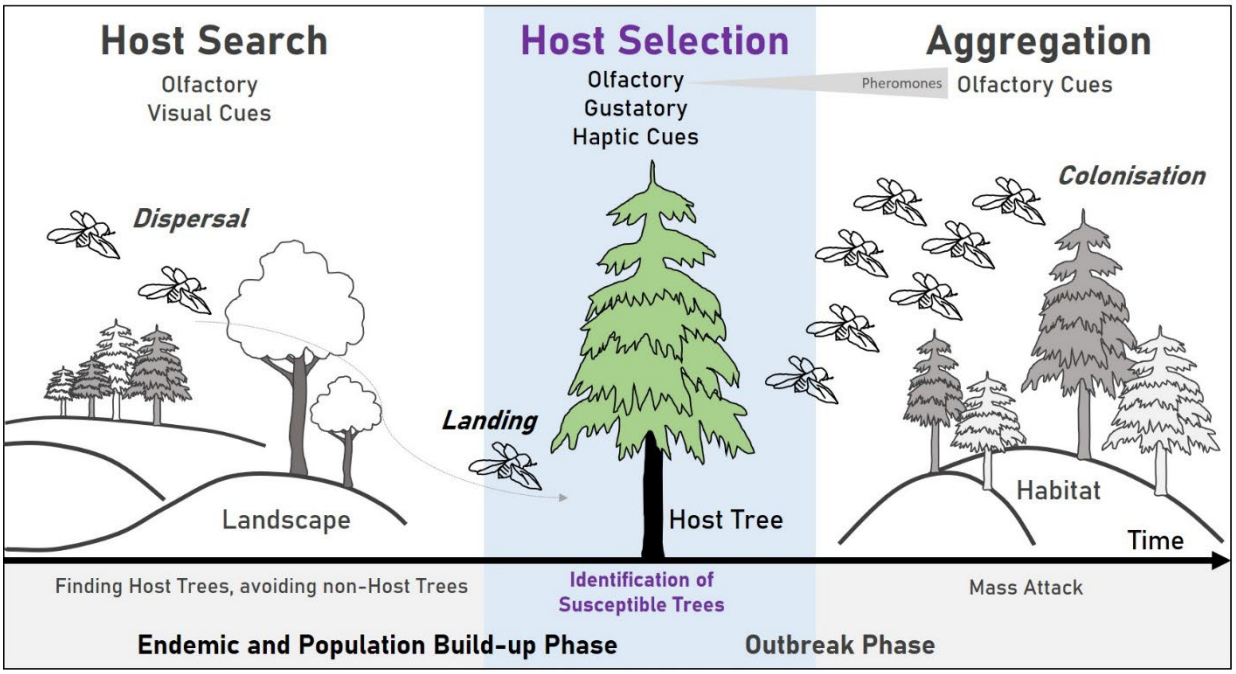
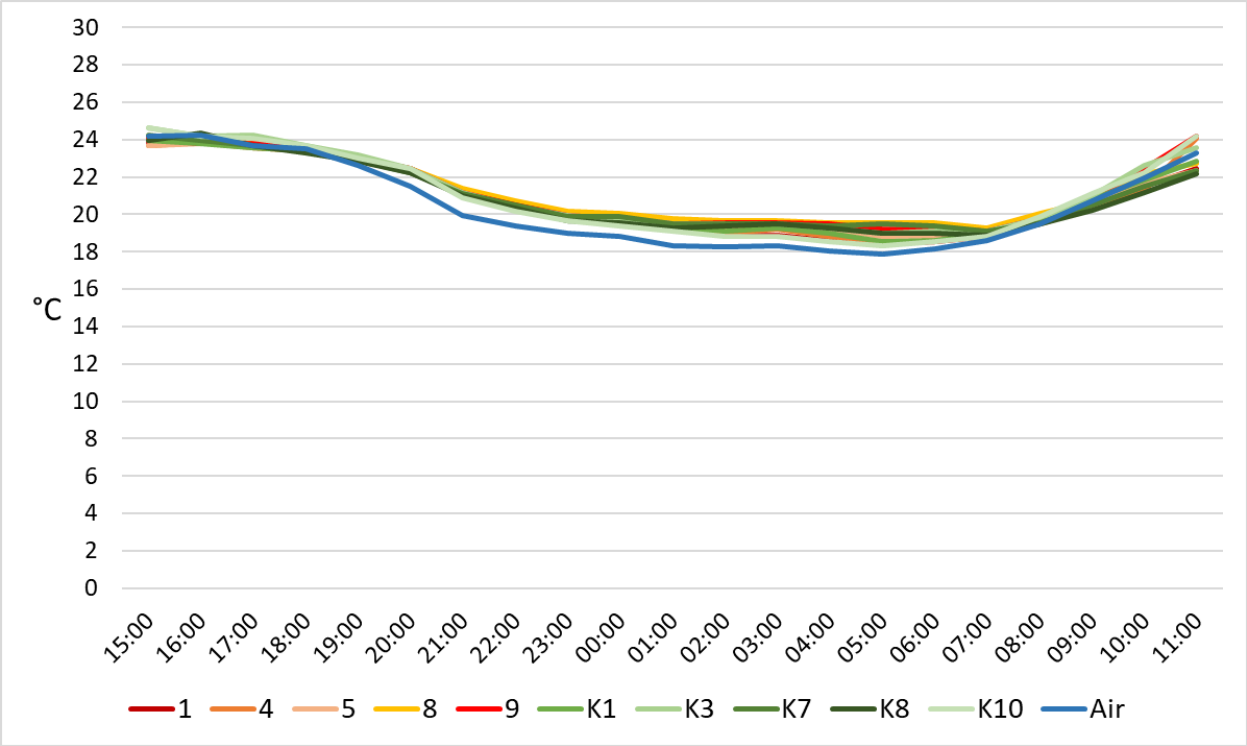


Fig. S2 Mean hourly temperatures recorded inside (*Picea abies* tree numbers 1-9, K1-K10) and outside (Air) the attack boxes during bioassays conducted from June 18 (3pm) to June 19 (11am), 2019. Mean, maximum and minimum box and air temperatures are summarized in the associated table.



Temp °C	1	4	5	8	9	K1	K3	K7	K8	K10	Air
Mean	20,80	20,83	20,90	21,22	21,18	20,89	21,21	21,02	20,87	20,97	20,47
Max	24,06	24,06	23,77	24,16	24,16	23,97	24,64	24,26	24,35	24,64	24,26
Min	18,43	18,52	18,81	19,28	19,09	18,52	19,00	19,09	18,90	18,33	17,86

Fig. S3 Host selection by *Ips typographus* in the attack box bioassays: number of defended (black) and successful (magenta) attacks and attack attempts (orange) as well as beetles on the bark (grey) summed for all 20 *Picea abies* study trees for 9 experimental dates in (a) season 1 (2019) and (b) season 2 (2020). Numbers of defended (black) and successful (magenta) attacks and attack attempts (orange) summed up over all bioassays (9 dates) per study tree (roof trees 1-10, control trees K1-K10) in (c) season 1 and (d) season 2. Numbers of beetles found in the start bottles, attack boxes, exit jars and lost beetles are not included.

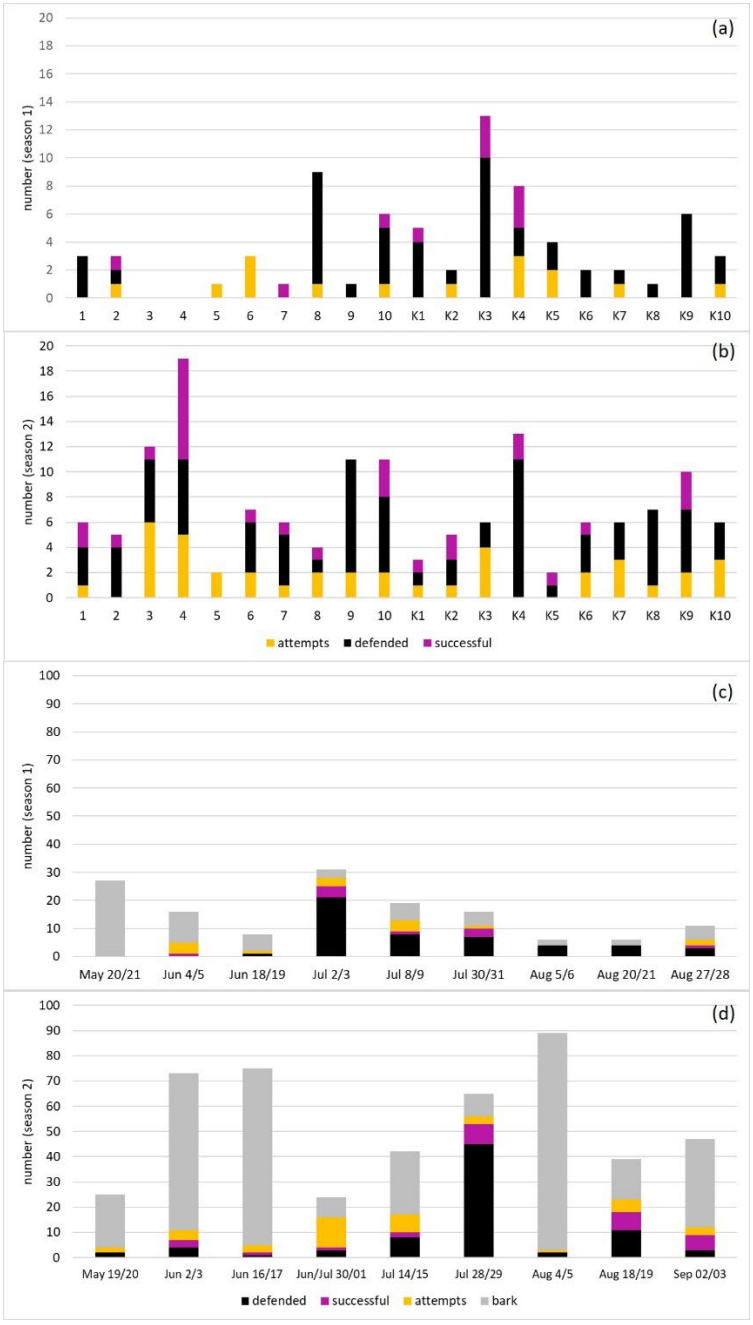


Fig. S4 Multiple linear regression plots for the Norway spruce (*Picea abies*) study trees of the roof and control treatments (red, 1-10; white, K1-10; n=20) with total number of *Ips typographus* attacks and attack attempts in 2020 plotted against seasonal (a) RF Max, maximum resin flow rates (T=-2.610; P=0.018) and (b) mean pre-dawn twig water potentials (TWP Mean x (-1); T=1.059; P=0.304); overall model fit (R^2=0.31, F(2, 17)=3.86; P=0.042). Linear regression plots for 6 roof (red) and 8 control (K, white) trees (n=14) with total number of attacks and natural logarithms of (c) total concentration of MT, monoterpenes in September (R^2=0.57, F(1, 12)=15.57; P=0.002) and (d) total concentration of DT, diterpenes in September (R^2=0.31, F(1, 12)=5.35; P=0.039). Boxplots on the right and above show the distributions of dependent and response variables. All boxplots show median, 25 and 75 percentiles with 1.5 x interquartile ranges

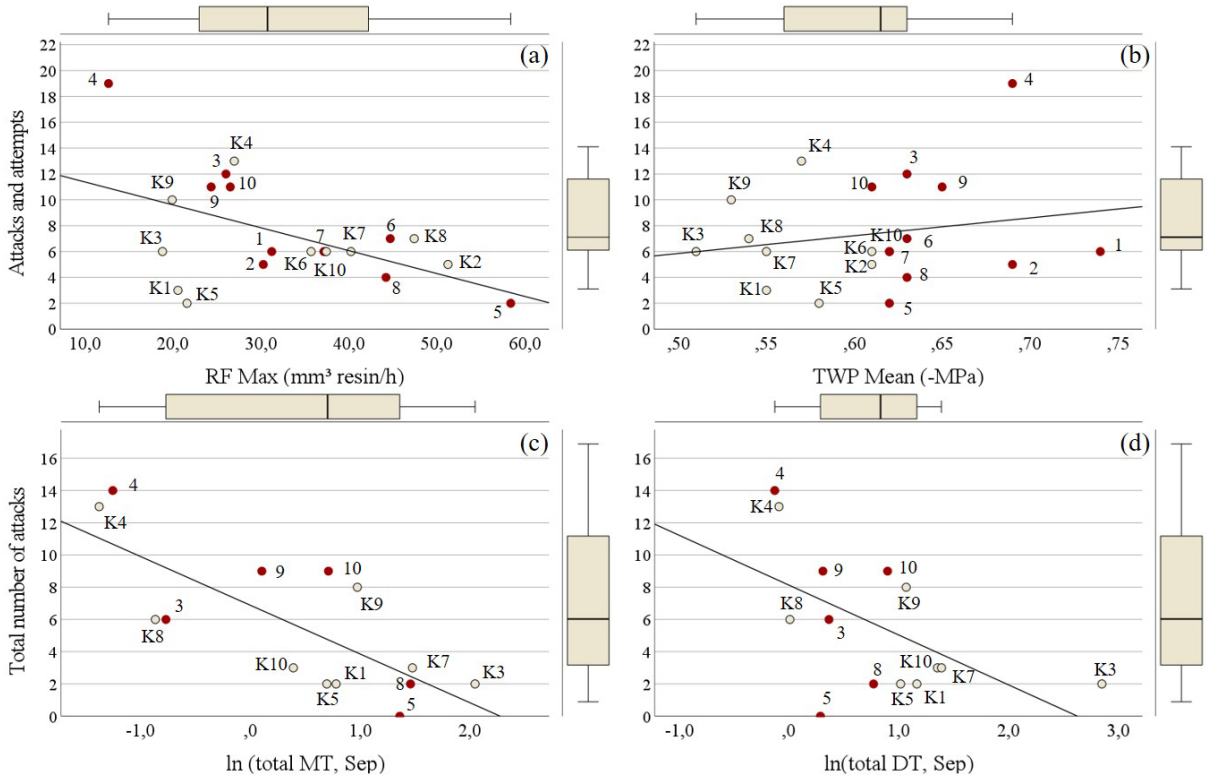


Fig. S5 Boxplots for mean lesion length established by *Picea abies* study trees in response to (a) *Grosmannia penicillata* (GP) and (b) *Endoconidiophora polonica* (EP) and for mean lesion area in response to (c) GP and (d) EP, recorded 2, 4, and 6 weeks past inoculation (wpi). All boxplots show median, 25 and 75 percentiles with 1.5 x interquartile ranges and outliers. Different letters indicate significant differences between control dates (repeated measures ANOVA; $P<0.05$).

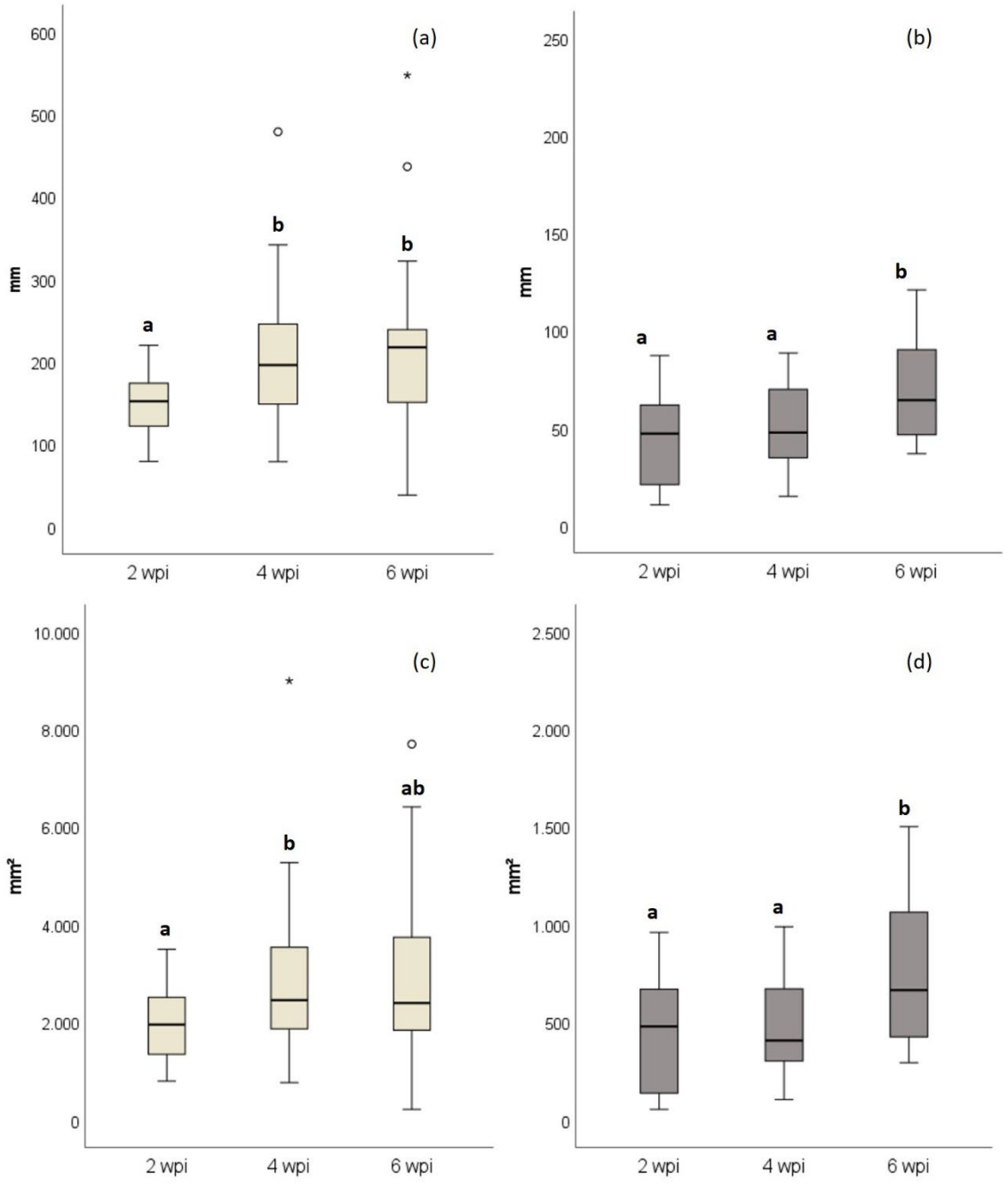


Table S1 Validation of the main study questions (Q1-Q6) and hypotheses (H1a-H6b) with regard to the observed interactions between Picea abies study trees (S), Ips typographus bark beetles (B), and bark beetle associated fungi (F): Yes (Y) results support the hypothesis; No (N) results do not support the hypothesis; ± results partly support the hypothesis.

		Interactions			Validation
	Main Questions (Q) and Hypotheses (H)	**S**	**B**	**F**	(Y)es, (N)o, ±
Q1	**How does treatment (roof/control) affect hydrology, tree physiology and growth?**				**Yes**
H1a	Roofs reduce soil water content, SWC (%) and twig water potential, TWP (MPa)				Yes
H1b	Resin flow rate, RF (mm^3 resin/ hr) differs between treatment groups				No
H1c	Weather, soil hydrological and tree physiological parameters are correlated				Yes
H1d	Roof trees have smaller tree rings (less carbon invested into growth)				Yes
Q2	**Is tree resistance/bark beetle host selection influenced by (duration of) drought?**				**Yes**
H2a	Host selection (successful, defended, attempted attacks) varies over time				Yes
H2b	Host selection patterns vary among trees and are influenced by treatment				Yes
H2c	Beetle behaviour and host selection are influenced by weather, TWP and RF				Yes
Q3	**Does drought affect host selectin via terpene and phenolic defenses?**				**±**
H3a	Mono- and diterpene concentrations (MT, DT, mg/g FW) are affected by drought				No
H3b	Total MT and DT concentrations are negatively correlated with host selection				Yes
H3c	Limonene and dehydroabietic acid are negatively correlated with host selection				Yes
H3d	Phenolic concentrations (mg/g FW) increase with drought				±
H3e	Flavonoid and stilbene concentrations are negatively correlated with host selection				±
H3f	Catechin and PB1 are negatively correlated with host selection				±
Q4	**Do drought and fungi affect hypersensitive wound reaction of spruce?**				**Yes**
H4a	Lesion size (2, 4, 6 weeks past inoculation, wpi) differs between EP and GP				Yes
H4b	Larger lesions are observed for drought-stressed trees (increased susceptibility)				Y(GP), ±(EP)
H4c	Lesion size is correlated with TWP and bark beetle host selection				Y(GP)
Q5	**Do drought, fungi and bark beetle attack induce terpene/phenolic defenses?**				**Yes/±**
H5a	Drought induces MT and DT accumulation in hypersensitive wound reaction zones				±(MT), Y(DT)
H5b	EP and GP induce accumulation of MT and DT in lesions; GP more than EP				Yes
H5c	Induced MT and DT concentrations and lesion size (caused by GP) are correlated				N(MT), Y(DT)
H5d	Terpene accumulation in response to GP is further stimulated by bark beetle attack				Yes
H5e	Induced concentrations of flavonoids and stilbenes differ between treatments				±(EP), N(GP)
H5f	EP and GP metabolize phenolics to a different extent				Yes
Q6	**Do drought and fungi affect carbon resources for tree defense and growth?**				**Yes**
H6a	Non-structural carbohydrate (NSC, mg/g FW) concentrations differ between treatments				±
H6b	EP and GP differentially affect NSC concentrations				Yes

Table S2 Number of Picea abies bark cores sampled from tissue without and with inoculation of fungi (EP, Endoconidiophora polonica; GP, Grosmannia penicillata; close (cl) or 5 cm below inoculation holes), taken from R, roof and K, control trees and analysed per date and compound group (MT, monoterpenes; DT, diterpene resin acids; Phen, phenolics; Sol S, soluble sugars; starch; NSC, non-structural carbohydrates).

			MT	DT	Phen	Sol S	Starch	NSC
Without Fungi	**May**	**R**	6	6	NA	NA	NA	NA
		K	8	8	NA	NA	NA	NA
	June	**R**	NA	NA	6	6	5	5
		K	NA	NA	8	6	6	6
	Sep	**R**	6	6	7	NA	NA	NA
		K	8	8	9	NA	NA	NA
With Inoculation of Fungi	**Aug (EP, cl)**	**R**	6	6	6	6	6	6
		K	8	8	7	6	6	6
	Aug (GP, cl)	**R**	6	6	4	6	6	6
		K	8	8	3	5	5	5
	Sep (EP, cl)	**R**	6	6	6	6	6	6
		K	8	8	7	6	6	6
	Sep (GP, cl)	**R**	6	6	2	5	5	5
		K	8	8	4	5	5	5
	Aug (EP, 5)	**R**	NA	NA	3	3	3	3
		K	NA	NA	5	3	3	3
	Aug (GP, 5)	**R**	NA	NA	5	6	6	6
		K	NA	NA	4	6	6	6
	Sep (EP, 5)	**R**	NA	NA	3	3	3	3
		K	NA	NA	5	3	3	3
	Sep (GP, 5)	**R**	NA	NA	3	6	6	6
		K	NA	NA	7	6	6	6

Table S3 (a) Mean values for pre-dawn twig water potential (Mean TWP), resin flow (Mean RF), and volumetric soil water content (Mean SWC) of R, roof and K, control Picea abies study trees, shown with 95% credible interval (CI), measured repeatedly during experimental seasons 1 (2019) and 2 (2020). Significant differences are indicated by bold numbers (ANOVA, P≤0.05*; P≤0.01**).

	Mean TWP (MPa)		Mean RF (mm³/ h)		Mean SWC (%)		95% CI (TWP)		95% CI (RF)	
Date	**R**	**K**	**R**	**K**	**R**	**K**	**R**	**K**	**R**	**K**
21 May 2019	-0.65	-0.63	8.79	4.26	**11.65**	**25.41****	(-0.72, -0.58)	(-0.67, -0.59)	(2.44, 15.15)	(1.02, 7.49)
05 June 2019	NA	NA	25.95	21.27	**11.45**	**24.94****	NA	NA	(15.86, 36.04)	(11.78, 30.76)
03 July 2019	**-0.65**	**-0.48****	37.01	25.73	**11.13**	**18.87****	**(-0.71, -0.59)**	**(-0.50, -0.46)**	(23.94, 50.08)	(13.92, 37.53)
31 July 2019	**-0.84**	**-0.54****	23.23	35.87	**9.65**	**15.95****	**(-0.90, -0.77)**	**-0.58, -0.51)**	(13.26, 33.19)	(23.19, 48.55)
28 Aug 2019	**-0.83**	**-0.62****	34.96	32.26	**8.88**	**14.58****	**(-0.92, -0.74)**	**(-0.66, -0.57)**	(23.92, 45.99)	(17.50, 47.02)
20 May 2020	**-0.85**	**-0.60****	18.13	12.81	9.32	11.35	**(-0.93, -0.77)**	**(-0.66, -0.54)**	(9.06, 27.19)	(5.38, 20.24)
17 June 2020	NA	NA	14.71	13.61	**9.17**	**17.93****	NA	NA	(5.49, 23.92)	(5.27, 21.95)
01 July 2020	**-0.54**	**-0.35****	28.47	18.02	**9.24**	**25.15****	**(-0.59, -0.48)**	**(-0.38, -0.33)**	(18.58, 38.36)	(9.27, 26.76)
14 July 2020	NA	NA	24.10	17.92	**9.26**	**23.58****	NA	NA	(13.37, 34.83)	(8.55, 27.29)
05 Aug 2020	**-0.57**	**-0.43****	6.90	14.48	**9.38**	**24.19****	**(-0.62, -0.51)**	**(-0.43, -0.39)**	(3.07, 10.73)	(6.29, 22.66)
19 Aug 2020	NA	NA	27.27	20.95	**9.07**	**25.22****	NA	NA	(20.68, 33.85)	(11.10, 30.80)
03 Sep 2020	NA	NA	11.23	13.39	**9.03**	**25.25****	NA	NA	(3.05, 19.40)	(4.40, 22.37)

Table S3 (b) Precipitation sum (P Sum) and minimum, mean, and maximum temperature (T Min, T Mean, T Max) recorded in the months April to September during study years 1 (2019) and 2 (2020).

	2019				2020			
Month	**P Sum (mm)**	**T Min (°C)**	**T Mean (°C)**	**T Max (°C)**	**P Sum (mm)**	**T Min (°C)**	**T Mean (°C)**	**T Max (°C)**
April	41.06	1.96	8.79	17.58	6.83	2.25	10.41	16.83
May	188.55	1.00	9.35	20.36	71.92	5.44	10.98	17.67
June	52.62	15.38	20.33	25.68	152.55	11.47	15.58	21.95
July	43.20	13.71	19.34	25.60	90.56	11.63	17.72	24.83
August	80.19	12.67	19.58	24.17	106.43	11.31	18.82	23.13
September	73.82	5.97	13.99	18.99	146.48	5.46	14.39	20.35
Sum/Mean	**479.45**	**8.45**	**15.23**	**22.06**	**574.77**	**7.93**	**14.65**	**20.73**

Table S4 Pearson correlations (r) of Picea abies physiological characteristics, weather, and soil hydrological parameters recorded during experimental season 2 (2020). High positive and negative correlations are marked by more intense orange and blue colours, respectively. TWP Mean, mean pre-dawn twig water potential; RF Mean, mean resin flow rates; T Mean, T Max, mean and maximum temperatures; P Mean, mean precipitation sum; SWC, volumetric soil water content for C, control and R, roof trees. Significant correlations are indicated by bold numbers (P ⩽0.05*; P⩽0.01**).

		TWP Mean	RF Mean	T Mean	T Max	P Sum	SWC (C)	SWC (R)
TWP Mean	*r*		-0.16	-0.15	-0.10	0.61	0.02	**0.80***
	P		0.725	0.751	0.837	0.148	0.970	**0.030**
	N		7	7	7	7	7	7
RF Mean	*r*			**0.95****	**0.87****	-0.45	-0.03	-0.37
	P			**<0.001**	**<0.001**	0.147	0.921	0.240
	N			12	12	12	12	12
T Mean	*r*				**0.93****	-0.19	0.10	-0.30
	P				**<0.001**	0.440	0.714	0.252
	N				18	18	17	17
T Max	*r*					-0.08	-0.04	-0.29
	P					0.742	0.873	0.252
	N					18	17	17
P Sum	*r*						-0.14	0.17
	P						0.602	0.513
	N						17	17
SWC (C)	*r*							0.08
	P							0.752
	N							17

Table S5 Correlations calculated between three parameters characterizing Ips typographus behaviour, Picea abies resin flow, and the climate parameters temperature and precipitation. Number of beetles on the bark - Spearman Rho correlation; number of beetles in attack box and exit - Pearson correlation (r). RF Mean, mean resin flow rates; T Mean and Max, mean and maximum temperatures; P Mean, mean precipitation sum from May to September of study season 2 (2020). Significant correlations are indicated by bold numbers (P≤0.05*; P≤0.01**).

		RF Mean	T Mean	T Max	P Sum
Beetles on Bark	*r*	**-0.91****	**-0.72****	**-0.69****	0.31
	P	<0.001	0.001	0.002	0.205
	N	12	18	18	18
Beetles in Attack Box	*r*	-0.01	-0.01	0.001	0.03
	P	0.983	0.982	0.995	0.911
	N	12	18	18	18
Beetles in Exit	*r*	**0.65***	**0.81****	**0.91****	0.18
	P	0.022	<0.001	<0.001	0.473
	N	12	18	18	18

Table S6 (a) Picea abies study tree bark contents of total monoterpenes and diterpene resin acids and individual compounds in mg/g fresh weight. Concentrations and SE, standard errors are listed for N, number of replicates per treatment group R, roof and K, control trees as levels measured in May and September in tissue without fungi inoculation and induced levels measured in August and September after the inoculation of EP, Endoconidiophora polonica and GP, Grosmannia penicillata. Significant differences between groups (independent samples t test; P⩽ 0.05*, P⩽0.001**) are indicated by bold numbers.

Terpenes	Treatment	N	May	SE	Sep	SE	Aug(EP)	SE	Sep(EP)	SE	Aug(GP)	SE	Sep(GP)	SE
Total **Monoterpenes**	R	6	3.601	2.114	2.017	0.707	52.385	13.753	60.412	13.202	69.078	7.798	69.178	8.074
	K	8	0.971	0.240	2.641	0.863	38.561	8.669	52.334	7.691	58.093	2.879	94.405	16.888
α-pinene	R	6	2.613	1.739	0.899	0.332	25.168	7.566	26.204	6.625	32.401	4.800	25.828	6.853
	K	8	0.397	0.080	1.133	0.421	13.959	2.947	17.884	2.397	22.470	1.159	36.686	7.779
β-pinene	R	6	0.553	0.204	0.961	0.364	19.430	4.298	22.900	4.501	26.151	2.522	29.203	1.275
	K	8	0.483	0.154	1.211	0.353	18.163	3.974	23.970	3.618	26.879	2.172	37.015	8.450
Limonene	R	6	0.256	0.143	0.152	0.064	5.708	1.558	7.411	1.769	7.593	1.141	8.661	1.079
	K	8	0.080	0.021	0.238	0.092	4.567	1.196	6.181	1.119	6.501	0.670	13.731	3.721
Camphene	R	6	0.137	0.121	0.001	0.000	0.512	0.158	**0.632***	**1.163**	**0.673***	**0.092**	0.855	0.232
	K	8	0.004	0.002	0.025	0.016	0.238	0.092	**0.280***	**0.052**	**0.339***	**0.044**	0.619	0.189
Myrcene	R	6	0.024	0.012	0.003	0.002	1.181	0.354	1.890	0.572	1.496	0.226	1.876	0.290
	K	8	0.004	0.002	0.026	0.012	0.904	0.274	1.297	0.258	1.280	0.232	3.161	1.039
Δ-3-carene	R	6	0.023	0.018	0.001	0.000	0.386	0.126	1.374	0.581	0.763	0.152	2.755	0.724
	K	8	0.002	0.001	0.009	0.006	0.734	0.374	2.722	0.801	0.624	0.199	3.193	1.293
Total **Diterpene resin acids**	R	6	4.255	2.216	1.607	0.240	34.438	5.732	**54.345***	**7.540**	**49.804***	**6.217**	**62.483***	**8.023**
	K	8	1.476	0.236	4.506	1.879	32.329	0.918	**31.606***	**0.865**	**28.523***	**1.191**	**32.828***	**0.956**
Sandaraco-pimaric acid	R	6	0.475	0.348	0.065	0.014	1.852	0.260	**2.446***	**0.266**	**2.850***	**0.503**	**3.075***	**0.482**
	K	8	0.095	0.021	0.187	0.074	1.584	0.110	**1.490***	**0.105**	**1.431***	**0.113**	**1.713***	**0.182**
Isopimaric acid	R	6	0.891	0.634	0.140	0.021	3.700	0.622	**4.621***	**0.401**	**5.193***	**0.924**	**5.569***	**0.627**
	K	8	0.190	0.037	0.372	0.127	3.475	0.232	**3.312***	**0.212**	**3.094***	**0.322**	**3.558***	**0.381**
Levopimaric acid	R	6	1.136	0.488	0.762	0.125	16.257	2.532	**26.705***	**4.485**	**21.278***	**2.930**	**30.317***	**4.818**
	K	8	0.486	0.059	1.651	0.487	15.110	0.949	**14.575***	**0.664**	**11.826***	**0.487**	**14.074***	**0.747**
Dehydro-abietic acid	R	6	0.539	0.255	0.159	0.035	3.509	0.905	3.750	0.662	**6.222***	**0.862**	**5.493***	**0.865**
	K	8	0.348	0.100	1.533	1.108	3.070	0.276	3.156	0.408	**3.508***	**0.475**	**3.242***	**0.482**
Abietic acid	R	6	0.617	0.373	0.194	0.031	3.184	0.623	**4.908***	**0.525**	4.541	0.753	5.714	0.832
	K	8	0.157	0.030	0.411	0.132	3.269	0.261	**3.481***	**0.186**	3.004	0.228	3.848	0.196
Neoabietic acid	R	6	0.597	0.268	0.287	0.042	5.936	1.268	**11.963***	**2.329**	**9.722***	**1.079**	**12.316***	**1.664**
	K	8	0.199	0.024	0.352	0.056	5.823	0.421	**5.593***	**0.279**	**5.660***	**0.388**	**6.394***	**0.226**

Table S6 (b) Picea abies study tree bark contents of total phenolics and individual compounds in mg/g fresh weight. Concentrations and SE, standard errors are listed for N, number of replicates per Treat, treatment group R, roof and K, control trees as levels measured in June and September in tissue without fungi inoculation and induced levels measured in August and September after the inoculation of Endoconidiophora polonica measured in August and September in hypersensitive wound reaction zones close (cl) and 5 cm below (5) the inoculation holes. Significant differences between groups (independent samples t test, P≤0.05*, P≤0.001**) are indicated by bold numbers.

Phenolics / EP	Treat	June	SE	N	Sep	SE	N	Aug (cl)	SE	N	Sep (cl)	SE	N	Aug (5)	SE	N	Sep (5)	SE	N
Total Phenolics	R	**13.282***	**1.044**	6	16.736	2.820	7	9.757	2.383	6	10.428	2.741	6	16.340	2.128	3	14.647	3.254	3
	K	**10.361***	**0.860**	8	11.281	2.688	9	8.699	1.546	7	6.986	2.355	7	9.838	2.165	5	10.620	1.454	5
Catechin	R	0.980	0.292	6	0.816	0.151	7	1.100	0.356	6	1.148	0.332	6	2.033	0.355	3	1.983	0.619	3
	K	0.766	0.133	8	0.482	0.120	8	0.793	0.179	7	0.930	0.426	7	1.250	0.403	5	1.158	0.200	5
Astringin	R	7.252	0.686	6	10.810	2.281	7	5.220	1.197	6	5.465	1.333	6	8.690	1.182	3	7.583	1.789	3
	K	6.093	0.488	8	6.844	2.227	8	4.901	0.943	7	3.520	1.144	7	5.274	1.189	5	6.060	0.862	5
Isorhapontin	R	**3.468***	**0.224**	6	**3.477***	**0.390**	7	2.198	0.607	6	2.363	0.765	6	**3.057***	**0.059**	3	2.497	0.020	3
	K	**2.115***	**0.288**	8	**1.898***	**0.396**	8	1.823	0.335	7	1.266	0.339	7	**1.730***	**0.284**	5	1.874	0.418	5
Taxifolin	R	0.648	0.091	6	0.741	0.134	7	0.440	0.103	6	0.503	0.121	6	0.827	0.192	3	0.813	0.160	3
	K	0.555	0.053	8	0.536	0.135	8	0.517	0.102	7	0.390	0.129	7	0.546	0.131	5	0.548	0.077	5
PB1	R	0.927	0.185	6	**0.891***	**0.171**	7	0.798	0.295	6	0.953	0.343	6	1.740	0.464	3	1.777	0.742	3
	K	0.834	0.165	8	**0.449***	**0.116**	8	0.667	0.133	7	0.876	0.460	7	1.034	0.317	5	0.984	0.189	5
Phenolics / GP	**Treat**							**Aug (cl)**	**SE**	**N**	**Sep (cl)**	**SE**	**N**	**Aug (5)**	**SE**	**N**	**Sep (5)**	**SE**	**N**
Total Phenolics	R							1.700	0.772	4	1.090	0.350	2	8.208	1.926	5	12.060	4.105	3
	K							1.133	0.204	3	0.745	0.186	4	7.158	0.645	4	10.404	1.963	7
Catechin	R							0.375	0.156	4	0.250	0.130	2	0.942	0.218	5	1.467	0.413	3
	K							0.253	0.079	3	0.183	0.064	4	0.928	0.229	4	1.530	0.313	7
Astringin	R							0.655	0.341	4	0.355	0.135	2	4.660	1.242	5	6.887	2.568	3
	K							0.287	0.127	3	0.210	0.123	4	3.478	0.454	4	5.099	1.102	7
Isorhapontin	R							0.128	0.039	4	0.165	0.055	2	1.490	0.290	5	1.973	0.716	3
	K							0.270	0.170	3	0.110	0.047	4	1.763	0.203	4	1.939	0.489	7
Taxifolin	R							0.205	0.118	4	0.070	0.010	2	0.416	0.124	5	0.590	0.210	3
	K							0.057	0.012	3	0.023	0.013	4	0.318	0.053	4	0.440	0.100	7
PB1	R							0.338	0.129	4	0.245	0.145	2	0.704	0.134	5	1.150	0.379	3
	K							0.263	0.079	3	0.225	0.067	4	0.673	0.137	4	1.396	0.358	7

Table S7 Pearson correlations (r) of Ips typographus attacks defended by resin flow observed in the study season 2020 and concentrations of total and individual monoterpenes (MT), diterpene resin acids (DT) and phenolic compounds (n=14) in Picea abies study trees.

		May	September
MT total	*r*	-0.48	**-0.60***
	P	0.084	**0.022**
camphene	*r*	-0.41	-0.23
	P	0.149	0.422
myrcene	*r*	-0.51	-0.21
	P	0.065	0.466
delta-3-carene	*r*	-0.42	-0.27
	P	0.137	0.358
alpha-pinene	*r*	-0.43	**-0.55***
	P	0.125	**0.043**
beta-pinene	*r*	-0.48	**-0.63***
	P	0.080	**0.016**
limonene	*r*	-0.53	**-0.53***
	P	0.053	**0.049**
DT total	*r*	-0.50	-0.32
	P	0.066	0.270
sandaracompimaric acid	*r*	-0.44	-0.39
	P	0.112	0.171
isopimaric acid	*r*	-0.43	-0.49
	P	0.120	0.127
levopimaric acid	*r*	-0.51	-0.32
	P	0.064	0.273
dehydroabietic acid	*r*	**-0.57***	-0.25
	P	**0.032**	0.383
abietic acid	*r*	-0.44	-0.31
	P	0.115	0.274
neoabietic acid	*r*	-0.47	**-0.57***
	P	0.094	**0.032**
catechin	*r*	-0.46	0.23
	P	0.098	0.426
astringin	*r*	-0.10	0.17
	P	0.745	0.558
isorhapontin	*r*	-0.13	-0.08
	P	0.667	0.795
taxifolin	*r*	0.29	**0.54***
	P	0.315	**0.049**
PB1	*r*	-0.39	0.35
	P	0.173	0.219

Table S8 (a) Picea abies study tree bark contents of total phenolics, Sol S, soluble sugars, starch, and NSC, non-structural carbohydrates. Concentrations and SE, standard errors are listed for N, number of replicates regarding levels measured in June and September in tissue without fungi inoculation and induced levels measured in August and September after the inoculation of EP, Endoconidiophora polonica and GP, Grosmannia penicillata in hypersensitive wound reaction zones close (cl) and 5 cm below (5) the inoculation holes. Significant differences between groups (independent samples t test, P≤0.05*, P≤0.001**) are indicated by bold numbers.

Date (no fungi)		**Total Phenolics**		**Sol S**		**Starch**		**NSC**	
June	**Mean**	11.613		30.134		35.572		66.192	
	SE	0.754		1.440		5.518		5.306	
	N	14		12		11		11	
Sep	**Mean**	13.668		NA		NA		NA	
	SE	2.012		NA		NA		NA	
	N	16		NA		NA		NA	
Date (induced)		**EP**	**GP**	**EP**	**GP**	**EP**	**GP**	**EP**	**GP**
Aug (cl)	**Mean**	**9.187****	**1.457****	**16.153****	**3.286****	10.886	6.768	**27.039***	**10.441***
	SE	**1.326**	**0.435**	**2828**	**0.735**	3.215	2.554	**5.772**	**2.744**
	N	**13**	**7**	**12**	**11**	12	12	**12**	**11**
	P	**< 0.001**		**< 0.001**		0.327		**0.020**	
Sep (cl)	**Mean**	**8.575****	**0.860****	**15.854***	**1.785***	13.050	5.492	**28.905***	**7.277***
	SE	**1.784**	**0.165**	**3.412**	**0.623**	3.641	1.179	**6.754**	**1.496**
	N	**13**	**6**	**12**	**10**	12	10	**12**	**10**
	P	**< 0.001**		**0.002**		0.069		**0.009**	
Aug (5)	**Mean**	**12.276***	**7.741***	**24.545***	**13.024***	**18.629***	**3.603***	**43.174****	**16.656****
	SE	**1.890**	**1.065**	**2.151**	**2.452**	**5.009**	**1.100**	**6.653**	**3.366**
	N	**8**	**9**	**6**	**12**	**6**	**12**	**6**	**12**
	P	**0.048**		**0.003**		**0.029**		**0.001**	
Sep (5)	**Mean**	12.130	10.901	**26.738****	**10.481****	**18.843***	**5.613***	**45.581****	**16.095****
	SE	1.560	1.728	**1.894**	**2.657**	**4.201**	**1.433**	**4.832**	**3.600**
	N	8	10	**6**	**12**	**6**	**12**	**6**	**12**
	P	0.605		**< 0.001**		**0.002**		**< 0.001**	

Table S8 (b) Picea abies study tree phloem contents of glucose, sucrose, fructose, and starch. Concentrations and SE, standard errors are listed for N, number of replicates regarding levels measured in June and September in tissue without fungi inoculation and induced levels measured in August and September after the inoculation of EP, Endoconidiophora polonica and GP, Grosmannia penicillata in hypersensitive wound reaction zones close (cl) the inoculation holes. Significant differences between groups (independent samples t test, P≤0.05*, P≤0.001**) are indicated by bold numbers.

		Glucose		Sucrose		Fructose		Sol S		Starch		NSC total	
Date/Treatment		**R**	**K**	**R**	**K**	**R**	**K**	**R**	**K**	**R**	**K**	**R**	**K**
June	**Mean**	4.235	3.208	22.002	20.508	5.947	4.368	32.183	28.084	39.802	32.047	73.467	60.131
	SE	1.06	0.481	0.730	0.863	1.220	1.153	2.424	1.249	11.041	4.991	9.468	5.226
	N	6	6	6	6	6	6	6	6	5	6	5	6
	P	0.402		0.217		0.314		0.174		0.547		0.228	
Aug (EP cl)	**Mean**	2.115	3.283	8.248	12.239	**2.042***	**4.378***	12.405	19.901	11.743	10.030	24.148	29.930
	SE	0.372	0.519	3.346	3.433	**0.461**	**0.592**	3.604	4.072	5.236	4.217	8.644	8.277
	N	6	6	6	6	**6**	**6**	6	6	6	6	6	6
	P	0.101		0.425		**0.011**		0.198		0.804		0.639	
Aug (GP cl)	**Mean**	2.435	1.361	0.214	0.815	1.059	1.047	3.708	2.780	11.015	2.522	14.723	5.302
	SE	0.802	0.465	0.059	0.547	0.245	0.362	1.070	1.064	4.622	0.407	4.317	1.172
	N	6	6	6	5	6	6	6	5	6	5	6	5
	P	0.274		0.334		0.973		0.558		0.097		0.086	
Sep (EP cl)	**Mean**	1.913	2.002	12.042	12.163	1.620	1.968	1.913	2.002	14.780	11.321	30.355	27.454
	SE	0.380	0.304	5.270	3.489	0.502	0.366	0.380	0.304	6.519	3.826	12.086	7.333
	N	6	6	6	6	6	6	6	6	6	6	6	6
	P	0.858		0.985		0.588		0.940		0.657		0.841	
Sep (GP cl)	**Mean**	0.831	1.277	0.125	0.147	0.537	0.654	1.493	2.077	**8.144***	**2.840***	9.638	4.917
	SE	0.233	0.757	0.034	0.080	0.151	0.424	0.347	1.258	**0.963**	**1.345**	0.975	2.517
	N	5	5	5	5	5	5	5	5	**5**	**5**	5	5
	P	.0589		0.813		0.802		0.666		**0.012**		0.118	

Methods S1 Analysis of phenolic compounds, profile

Phenolic compounds were separated on a Zorbax Eclipse XDB-C18 column (4.6 x 50 mm, 1.8 μm; Agilent) using mobile phase 0.05% (v/v) formic acid (phase A) and acetonitrile (phase B) at a flow rate 1.1 ml min−1 with the following profile:

0–1 min, 100% A, 0% B; 1–7 min, 0–65% B; 7–7.01 min, 65–100% B; 7.01–8 min, 100% B; 8–8.01 min, 100–0% B; 8.01–10 min, 0% B. The MS was operated as follows: negative ionization mode; ion spray voltage, −4200 V; turbo gas temperature, 700 ◦C; nebulizing gas, 70 p.s.i.; curtain gas, 30 p.s.i.; heating gas, 60 p.s.i.; and collision gas at 10 p.s.i. Multiple reaction monitoring was used to analyze the parent ion → product ion: m/z 288.9 → 109.1 for catechin; m/z 576.9 → 289.1 for proanthocyanidin B1; m/z 404.8 → 243 for astringin; and m/z 418.9 → 257.1 for isorhapontin.