

Supplementary Material

1 Supplementary Figure and Tables

1.1 Supplementary Figure



□Main tunnel Side tunnel Brood tunnel Old gallery ■ Dead female

Supplementary Figure 1. Presence of the five fungal isolates in the three gallery compartments, old galleries and associated with dead adult females. Twelve samples were taken from each compartment and from old galleries; four samples from dead females. Presence was recorded as yes or no.



1.2 Supplementary Tables

Supplementary Table 1. Composition of eight *X. affinis* laboratory galleries between 55 and 61 days of age, when the first generation of offspring matured and started to disperse.

		Immature stages						Adult ♀	9		
Gallery	Age (d)	Eggs	1 st instar	2 nd /3 rd instar	Pupae	Teneral ♀♀	Adult ∂∂	Non-developed ovaries	Developed ovaries	Egg- laying	Dispersing
А	61	18	1	4	24	-	1	7	3	-	3
В	58	42	1	-	-	-	1	-	-	4	2
С	61	20	3	-	1	-	-	-	-	3	5
D	58	22	8	3	1	2	-	2	6	1	14
E	57	53	8	5	-	-	1	2	2	5	1
F	60	19	-	1	5	-	1	3	1	3	8
G	61	92	5	-	-	-	1	-	1	4	3
Н	55	3	-	-	12	-	1	4	-	3	-



Supplementary Table 2. Separate logistic regression models to examine factors influencing adult females to lay eggs, develop ovaries or disperse.

Proportion of adult $\bigcirc \bigcirc$	Parameter	coeff. \pm se	Z	р
Egg-laying	Intercept	2.7 ± 2.2	1.25	0.21
	Proportion immature offspring*	not signi	ficant	
	Proportion of $\ensuremath{\mathbb{Q}}\ensuremath{\mathbb{Q}}$ inside nest, non-developed ovaries	-0.84 ± 0.35	-2.41	0.016
	Proportion of ♀♀ inside nest, developed ovaries	-0.56 ± 0.26	-2.16	0.031
	Proportion of all $\bigcirc \bigcirc$, dispersed*	not signi	ficant	
Developed ovaries	Intercept	-4.37 ± 2.78	-1.57	0.12
	Proportion of immature offspring*	not signi		
	Proportion of $\ensuremath{\mathbb{Q}}\ensuremath{\mathbb{Q}}$ inside nest, egg-laying	-0.61 ± 0.3	-2.04	0.042
	Proportion of $\ensuremath{\mathbb{Q}}\ensuremath{\mathbb{Q}}$ inside nest, non-developed ovaries	-0.61 ± 0.25	-2.45	0.013
	Proportion of all $\bigcirc \bigcirc$, dispersed*	not signi	ficant	
Dispersed	Intercept	1.44 ± 0.87	1.66	0.1
	Proportion of immature offspring*	not signi	ficant	
	Proportion of $\bigcirc \bigcirc \bigcirc$ inside nest, egg- laying*	not signi	ficant	
	Proportion of $\bigcirc \bigcirc \bigcirc$ inside nest, non- developed ovaries*	not signi	ficant	
	Proportion of ♀♀ inside nest, developed ovaries	-0.39 ± 0.14	-2.68	0.007

Example structure of the model for *proportion of egglayers* before step-wise model reduction using ANOVA analysis of log-likelihood scores: model <- glm (*propegglayers* ~ *propimmatures* + *propnondeveloped* + *propdeveloped* + *propdispersers*, binomial)

*- variables not in the final model.

Supplementary Table 3. Influence of gallery compartment and presence of the different fungi upon the number of inhabitants.

Offspring numbers	Parameter	coeff. \pm se	Z	р
Eggs	Intercept	-15.2 ± 999	0.0	1
	Presence of Mucor	$\textbf{-1.07} \pm 1.03$	-1.04	0.36
	Presence of Raffaelea	always present		
	Presence of Fusarium	19.03 ± 999	0	1
	Presence of Phaeoacremonium	$\textbf{-1.18} \pm 1.15$	-1.02	0.36
	Presence of Unknown fungus	0.17 ± 0.69	0.25	0.82
Larvae	Intercept (main tunnel)	-1.26 ± 0.86	-1.46	0.14
	Contrast main vs. side-tunnel	$\boldsymbol{2.57 \pm 0.79}$	3.24	0.001
	Contrast main vs. brood-tunnel	$\textbf{3.55} \pm \textbf{0.86}$	4.15	<0.001
	Contrast side vs. brood-tunnel	$\boldsymbol{0.98 \pm 0.45}$	2.18	0.03
	Presence of Mucor	$\textbf{-0.64} \pm 0.45$	-1.42	0.16
	Presence of Raffaelea	always present		
	Presence of Fusarium	$\textbf{-0.15} \pm 0.35$	-0.43	0.67
	Presence of Phaeoacremonium	0.07 ± 0.56	0.12	0.91
	Presence of Unknown fungus	-0.04 ± 0.54	-0.08	0.94
Adult ♀♀	Intercept (main tunnel)	2.8 ± 0.32	8.77	<0.001
	Contrast main vs. side-tunnel	0.16 ± 0.18	0.9	0.37
	Contrast main vs. brood-tunnel	-0.41 ± 0.21	-1.93	0.054
	Contrast side vs. brood-tunnel	$\textbf{-0.57} \pm \textbf{0.21}$	-2.71	0.007
	Presence of Mucor	$\textbf{-0.13} \pm 0.23$	-0.54	0.59
	Presence of Raffaelea	always present		
	Presence of Fusarium	0.08 ± 0.22	0.39	0.69
	Presence of Phaeoacremon.	$\textbf{-0.58} \pm \textbf{0.21}$	-2.8	0.005
	Presence of Unknown fungus	-0.25 ± 0.24	-1.02	0.31
Adult 33	<u>Fisher's exact test (N = 17 observation</u>	ons)		
	Contrast main (N = 3) vs. side-tunnel	(N = 12)		0.064
	Contrast main $(N = 3)$ vs. brood-tunn	el(N = 2)		1
	Contrast side (N = 12) vs. brood-tunnel (N = 2)			

Separate GEE models with an exchangeable correlation structure of the response variable within a cluster (gallery-identity), for examining differences in the number of eggs, larvae, adult females and

males between the three gallery compartments and depending on the presence of the five fungal morphospecies. Eggs were only found in the brood-tunnel. Model coefficients are reported as coeff. \pm se (standard error of the estimate), with the group in brackets in the first row of the model as the reference category (coefficient set to zero). The influences of independent variables on the fungal frequencies are displayed as contrasts between classes to give a better understanding (i.e., pairwise comparisons). A positive contrast denotes that the mean of the second class is higher than the mean of the first class; a negative contrast denotes the reverse.

Proportion of larvae	Parameter	$coeff. \pm se$	Z	р
Allogrooming ¹	Intercent (side tunnel)	2.51 ± 0.53	176	<0.001
Allogrooming	intercept (side-tunner)	-2.31 ± 0.33	-4.70	\0.001
	Contrast side vs. brood-tunnel	1.23 ± 0.56	2.2	0.028
Fungus cropping ¹	Intercept (side-tunnel)	$\textbf{-1.57}\pm0.39$	-4.06	<0.001
	Contrast side vs. brood-tunnel	1.02 ± 0.41	2.47	0.013
		2.02 + 1.01	2 00	.0.001
Cannibalism	Intercept (side-tunnel)	-3.93 ± 1.01	-3.89	<0.001
	Contrast side vs. brood-tunnel	Only present i	in side-t	unnel
Inactivity ¹	Intercept (side-tunnel)	-2.25 ± 0.68	-3.29	0.001
	Contrast side vs. brood-tunnel	0.79 ± 0.59	1.34	0.18
T		0.07 + 0.27	5 50	-0.001
Locomotion	Intercept (brood-tunnel)	-2.07 ± 0.37	-5.53	<0.001
	Contrast main vs. side tunnel	Only behavior	r in maiı	n-tunnel
	Contrast main vs. brood-tunnel	Only behavior	r in maiı	n-tunnel
	Contrast side vs. brood-tunnel	-2.17 ± 0.41	-5.26	<0.001
Being pushed by adult ¹	Intercept (brood-tunnel)	-4.61 ± 0.83	-5.56	<0.001
- •	Contrast side vs. brood-tunnel	Only present i	in brood	-tunnel
	Contrast since vs. Droou-tunner	only present		-tunnet

Supplementary Table 4. Influence of gallery compartment upon the behavior of larvae.

Separate GEE models with an exchangeable correlation structure of the response variable within a cluster (gallery-identity), for examining differences in behavioral frequencies between the three gallery compartments. Model coefficients are reported as coeff. \pm se (standard error of the estimate), with the group in brackets in the first row of the model as the reference category (coefficient set to zero). The influences of independent variables are displayed as contrasts between classes to give a better understanding (i.e., pairwise comparisons). A positive contrast denotes that the mean of the second class is higher than the mean of the first class; a negative contrast denotes the reverse.

¹ Not present in main-tunnel.

Proportion of adult \bigcirc	Parameter	$coeff. \pm se$	Z	р
Shuffling frass	Intercept (side-tunnel)	-0.6 ± 0.14	-4.14	<0.001
	Contrast main vs. side tunnel	$\textbf{-0.42} \pm 0.22$	-1.86	0.062
	Contrast main vs. brood-tunnel	-0.04 ± 0.31	-0.12	0.9
	Contrast side vs. brood-tunnel	0.46 ± 0.3	1.52	0.13
Blocking	Intercept (main-tunnel)	-2.42 ± 1.32	-1.84	0.066
	Contrast main vs. side tunnel	Only present i	n main-	tunnel
	Contrast main vs. brood-tunnel	Only present i	n main-	tunnel
Digging	Intercept (side-tunnel)	0.0 ± 1.41	0.0	1
	Contrast main vs. side tunnel	Only present i	n side-t	unnel
	Contrast main vs. brood-tunnel	Only present i	n brood	-tunnel
	Contrast side vs. brood-tunnel	24.6 ± 999	0.0	1
Allogrooming	Intercept (side-tunnel)	-1.5 ± 0.23	-6.5	<0.001
	Contrast main vs. side tunnel	$\textbf{-0.11} \pm 0.42$	-0.27	0.79
	Contrast main vs. brood-tunnel	0.56 ± 0.48	1.17	0.24
	Contrast side vs. brood-tunnel	0.67 ± 0.39	1.7	0.089
Self-grooming	Intercept (side-tunnel)	$\textbf{-1.83}\pm0.36$	-5.09	<0.001
	Contrast main vs. side tunnel	$\textbf{-0.51} \pm 0.48$	-1.05	0.3
	Contrast main vs. brood-tunnel	0.22 ± 1.2	0.19	0.85
	Contrast side vs. brood-tunnel	0.73 ± 1.21	0.6	0.55
Fungus cropping	Intercept (main-tunnel)	$\textbf{-1.18} \pm 0.29$	-4.12	<0.001
	Contrast main vs. side tunnel	0.19 ± 0.33	0.57	0.57
	Contrast main vs. brood-tunnel	1.18 ± 0.36	3.23	0.001
	Contrast side vs. brood-tunnel	0.99 ± 0.27	3.57	<0 001

Supplementary Table 5. Influence of gallery compartment upon the behavior of adult females.

Cannibalism	Intercept (brood-tunnel)	$\textbf{-1.39}\pm0.79$	-1.75	0.08	
	Contrast main vs. side tunnel	ntrast main vs. side tunnel Only present in side-tu		unnel	
	Contrast main vs. brood-tunnel	Only present in brood-tunn		-tunnel	
	Contrast side vs. brood-tunnel	-0.29 ± 1.14	-0.25	0.8	
Inactivity	Intercept (side-tunnel)	-1.13 ± 0.23	-4.88	<0.001	
	Contrast main vs. side tunnel	$\textbf{-0.89} \pm \textbf{0.3}$	-3.0	0.003	
	Contrast main vs. brood-tunnel	$\textbf{-0.77} \pm 0.42$	-1.84	0.066	
	Contrast side vs. brood-tunnel	0.12 ± 0.43	0.27	0.78	
Locomotion	Intercept (brood-tunnel)	0.0 ± 1.41	0	1	
	Contrast main vs. side tunnel	$\textbf{-0.23} \pm 0.32$	-0.7	0.48	
	Contrast main vs. brood-tunnel	0.77 ± 1.44	0.53	0.59	
	Contrast side vs. brood-tunnel	1.0 ± 1.42	0.7	0.48	
Pushing others	Intercept (brood-tunnel)	-1.61 ± 1.1	-1.47	0.14	
	Contrast main vs. side tunnel	Only present in side-tunnel			
	Contrast main vs. brood-tunnel	Only present i	n brood	-tunnel	
	Contrast side vs. brood-tunnel	-0.54 ± 1.19	-0.46	0.65	

Separate GEE models with an exchangeable correlation structure of the response variable within a cluster (gallery-identity), for examining differences in behavioral frequencies between the three gallery compartments. Model coefficients are reported as coeff. \pm se (standard error of the estimate), with the group in brackets in the first row of the model as the reference category (coefficient set to zero). The influences of independent variables are displayed as contrasts between classes to give a better understanding (i.e., pairwise comparisons). A positive contrast denotes that the mean of the second class is higher than the mean of the first class; a negative contrast denotes the reverse.

Supplementary Table 6. Influence of culture media and origin of sample (gallery compartment) upon the abundance of fungi associated with *Xyleborus affinis*.

Fungal isolates	Parameter	coeff. \pm se	Z	р
Mucor	Intercept (BMA)	-2.16 ± 0.86	-2.2	0.012
	Contrast BMA vs. MA	-0.23 ± 0.51	-0.44	0.66
	Contrast BMA vs. CSMA	-1.56 ± 0.61	-2.59	0.01
	Contrast MA vs. CSMA	-1.34 ± 0.42	-3.22	0.001
	Intercept (main tunnel)	-1.88 ± 0.74	-2.55	0.011
	Contrast main vs. side tunnel	$\textbf{-0.41} \pm 0.38$	-1.08	0.28
	Contrast main vs. brood-tunnel	$\textbf{-1.78} \pm \textbf{0.46}$	-3.83	<0.001
	Contrast side vs. brood-tunnel	-1.37 ± 0.46	-3.1	0.003
Raffaelea	Intercept (BMA)	1.19 ± 0.38	3.1	0.002
	Contrast BMA vs. MA	-1.49 ± 0.35	-4.27	<0.001
	Contrast BMA vs. CSMA	0.08 ± 0.39	0.21	0.83
	Contrast MA vs. CSMA	1.57 ± 0.3	5.26	<0.001
	Intercept (main tunnel)	0.36 ± 0.28	1.26	0.21
	Contrast main vs. side tunnel	-0.23 ± 0.28	-0.82	0.41
	Contrast main vs. brood-tunnel	0.44 ± 0.29	1.55	0.12
	Contrast side vs. brood-tunnel	0.67 ± 0.29	2.35	0.019
Fusarium	Intercept (BMA)	$\textbf{-2.03}\pm0.73$	-2.76	0.006
	Contrast BMA vs. MA	1.25 ± 0.41	3.04	0.002
	Contrast BMA vs. CSMA	$\textbf{-1.38} \pm \textbf{0.53}$	-2.6	0.009
	Contrast MA vs. CSMA	-2.63 ± 0.5	-5.24	<0.001
	Intercept (main tunnel)	-1.3 ± 0.63	-2.07	0.039
	Contrast main vs. side tunnel	$\textbf{-0.36} \pm 0.36$	-0.98	0.33
	Contrast main vs. brood-tunnel	-0.25 ± 0.35	-0.7	0.49

	Contrast side vs. brood-tunnel	0.11 ± 0.36	0.3	0.76
Phaeoacremonium	Intercept (BMA)	$\textbf{-2.33}\pm0.52$	-4.52	<0.001
	Contrast BMA vs. MA	$\textbf{-1.85} \pm \textbf{0.68}$	-2.71	0.007
	Contrast BMA vs. CSMA	$\textbf{-0.27} \pm 0.63$	-0.42	0.67
	Contrast MA vs. CSMA	1.59 ± 0.66	2.39	0.017
	Intercept (main tunnel)	$\textbf{-2.16} \pm \textbf{0.41}$	-5.29	<0.001
	Contrast main vs. side tunnel	$\textbf{-1.58} \pm \textbf{0.61}$	-2.59	0.01
	Contrast main vs. brood-tunnel	$\textbf{-1.68} \pm \textbf{0.61}$	-2.75	0.006
	Contrast side vs. brood-tunnel	-0.1 ± 0.76	-0.13	0.9
Unknown fungus	Intercept (BMA)	$\textbf{-4.67} \pm 0.87$	-5.37	<0.001
	Contrast BMA vs. MA	Only present on BMA		
	Contrast BMA vs. CSMA	$\textbf{3.11} \pm \textbf{0.84}$	3.73	<0.001
	Contrast MA vs. CSMA	Only present	on CSM	A
	Intercept (main tunnel)	$\textbf{-3.74} \pm 0.63$	-5.94	<0.001
	Contrast main vs. side tunnel	0.07 ± 0.58	0.12	0.91
	Contrast main vs. brood-tunnel	0.82 ± 0.5	1.63	0.1
	Contrast side vs. brood-tunnel	0.75 ± 0.52	1.44	0.15

Separate GEE models with an exchangeable correlation structure of the response variable within a cluster (gallery-identity), for examining differences in the isolation frequency between the culture media (BMA – benomyl-malt agar vs. MA – malt-extract agar vs. CSMA – cycloheximide-streptomycin-malt agar) and locations within the gallery (main tunnel vs. side tunnel vs. brood tunnel). Model coefficients are reported as coeff. \pm se (standard error of the estimate), with the group in brackets in the first row of the model as the reference category (coefficient set to zero). The influences of independent variables on the fungal frequencies are displayed as contrasts between classes to give a better understanding (i.e., pairwise comparisons). A positive contrast denotes that the mean of the second class is higher than the mean of the first class; a negative contrast denotes the reverse.

Supplementary Table 7. Influence of gallery compartment and presence of the different fungi upon the frequency of particular adult female behaviors.

Proportion of adult $\bigcirc \bigcirc$	Parameter	coeff. \pm se	Z	р
Fungus cropping	Intercept (main tunnel)	$\textbf{-2.77} \pm 0.52$	-5.33	<0.001
	Contrast main vs. side-tunnel	$\boldsymbol{1.05\pm0.45}$	2.34	0.019
	Contrast main vs. brood-tunnel	$\textbf{1.49} \pm \textbf{0.46}$	3.21	0.001
	Contrast side vs. brood-tunnel	0.45 ± 0.42	1.06	0.29
	Presence of Mucor	0.68 ± 0.39	1.73	0.084
	Presence of Raffaelea	always preser	nt	
	Presence of Fusarium	0.22 ± 0.38	0.59	0.56
	Presence of Phaeoacremonium	$\textbf{-0.41} \pm 0.43$	-0.95	0.34
	Presence of Unknown fungus	0.94 ± 0.46	2.07	0.038
Shuffling frass	Intercept (main tunnel)	$\textbf{-0.9}\pm0.42$	-2.13	0.033
	Contrast main vs. side-tunnel	$\textbf{-0.63} \pm 0.34$	-1.87	0.061
	Contrast main vs. brood-tunnel	$\textbf{-0.68} \pm 0.39$	-1.74	0.082
	Contrast side vs. brood-tunnel	$\textbf{-0.04} \pm 0.42$	-0.11	0.92
	Presence of Mucor	0.44 ± 0.37	1.2	0.23
	Presence of Raffaelea	always preser	nt	
	Presence of Fusarium	$\boldsymbol{0.71\pm0.36}$	1.98	0.048
	Presence of Phaeoacremonium	$\textbf{-0.11} \pm 0.31$	-0.35	0.72
	Presence of Unknown fungus	0.27 ± 0.37	0.72	0.47
Inactive	Intercept (main tunnel)	$\textbf{-}1.13\pm0.79$	-1.43	0.15
	Contrast main vs. side-tunnel	0.07 ± 0.51	0.14	0.89
	Contrast main vs. brood-tunnel	$\textbf{-0.52} \pm 0.61$	-0.85	0.39
	Contrast side vs. brood-tunnel	$\textbf{-0.59} \pm 0.67$	-0.88	0.38
	Presence of Mucor	$\textbf{-0.47} \pm 0.64$	-0.73	0.47
	Presence of Raffaelea	always preser	nt	
	Presence of <i>Fusarium</i>	$\textbf{-1.38} \pm \textbf{0.6}$	-2.32	0.02
	Presence of Phaeoacremon.	$\boldsymbol{1.79 \pm 0.57}$	3.14	0.002
	Presence of Unknown fungus	$\textbf{-0.51} \pm 0.65$	-0.79	0.43

Separate GEE models with an exchangeable correlation structure of the response variable within a cluster (gallery-identity), for examining differences in behavioral frequencies between the three gallery compartments and the five fungal morphospecies. Model coefficients are reported as coeff. \pm se (standard error of the estimate), with the group in brackets in the first row of the model as the reference category (coefficient set to zero). The influences of independent variables on the behavioral frequencies are displayed as contrasts between classes to give a better understanding (i.e., pairwise comparisons). A positive contrast denotes that the mean of the second class is higher than the mean of the first class; a negative contrast denotes the reverse.

Fungal abundances	Parameter	$coeff. \pm se$	Z	р
Mucor	Intercept	$\textbf{-}1.9\pm0.56$	-3.4	<0.001
	Fungus cropping larvae	0.49 ± 0.96	0.51	0.61
	Inactive larvae	-1.1 ± 1.51	-0.73	0.47
	Intercept	$\textbf{-2.64} \pm 0.98$	-2.7	0.007
	Cropping adult females	1.48 ± 1.29	1.15	0.25
	Inactive adult females	2.56 ± 1.4	1.83	0.067
	Shuffling adult females	-1.1 ± 1.23	-0.9	0.37
Raffaelea	Intercept	0.24 ± 0.29	0.84	0.4
	Fungus cropping larvae	$\textbf{-}0.7\pm0.65$	-1.08	0.28
	Inactive larvae	$\textbf{2.3} \pm \textbf{0.95}$	2.42	0.016
	Intercept	$\textbf{-}0.3\pm0.61$	-0.5	0.62
	Cropping adult females	0.42 ± 0.94	0.45	0.66
	Inactive adult females	0.97 ± 1.09	0.89	0.37
	Shuffling adult females	0.91 ± 0.89	1.03	0.3
Fusarium	Intercept	$\textbf{-}1.08\pm0.81$	-1.34	0.18
	Fungus cropping larvae	$\textbf{-0.45} \pm 0.82$	-0.55	0.58
	Inactive larvae	-2.74 ± 2.3	-1.19	0.23
	Intercept	-2.3 ± 1.23	-1.88	0.06
	Cropping adult females	0.68 ± 1.28	0.53	0.6
	Inactive adult females	0.85 ± 2.02	0.42	0.67
	Shuffling adult females	0.91 ± 1.42	0.64	0.52
Phaeoacremonium	Intercept	$\textbf{-3.51}\pm0.9$	-3.91	<0.001
	Fungus cropping larvae	1.71 ± 1.48	1.16	0.25

Supplementary Table 8. Influence of the frequency of specific larval and adult female behaviors upon the frequency of the five different fungal isolates.

	Inactive larvae	-3.09 ± 4.78	-0.65	0.52
	•		0.00	0.000
	Intercept	-4.04 ± 1.32	-3.06	0.002
	Cropping adult females	2.01 ± 1.97	1.02	0.31
	Inactive adult females	3.18 ± 2.03	1.57	0.12
	Shuffling adult females	-0.08 ± 1.88	-0.04	0.97
Unknown fungus	Intercept	$\textbf{-2.36} \pm 0.48$	-4.91	<0.001
	<i>Fung. cropping</i> larvae	$\textbf{2.36} \pm \textbf{0.82}$	2.86	0.004
	Inactive larvae	$\textbf{-4.36} \pm \textbf{3.49}$	-1.25	0.21
	Intercept	-2.66 ± 1.06	-2.52	0.012
	Cropping adult females	0.77 ± 1.54	0.5	0.62
	Inactive adult females	-2.2 ± 2.46	-0.9	0.37
	Shuffling adult females	1.67 ± 1.46	1.15	0.25

Separate GEE models with an exchangeable correlation structure of the response variable within a cluster (gallery-identity), for examining differences in fungal frequencies per gallery depending on the frequency of inactivity and of potential fungus cleaning behaviors (*fungus cropping* and *shuffling frass*). Model coefficients are reported as coeff. \pm se (standard error of the estimate).