

A novel *in silico* approach for identifying defense-related biomarkers from *Neurospora crassa* during plant associations to understand pathogenicity mechanisms

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Supplementary Data

Table 1 — Experimental samples of GSE34098 dataset

S. No	Accession	Title
1	GSM841738	WT Avicel-4h_transfer from 16h MM@25C vs WT MM-4h_transfer from 16h MM@25C[13927384]
2	GSM841739	WT MM-4h_transfer from 16h MM@25C vs WT Avicel-4h_transfer from 16h MM@25C[13927383]
3	GSM841740	WT MM-4h_transfer from 16h MM@25C vs WT Avicel-4h_transfer from 16h MM@25C[13927193]
4	GSM841741	WT Avicel-4h_transfer from 16h MM@25C vs WT MM-4h_transfer from 16h MM@25C[13927197]
5	GSM841742	WT MM-4h_transfer from 16h MM@25C vs WT Avicel-4h_transfer from 16h MM@25C[13929871]
6	GSM841743	xlr-1 MM-4h_transfer from 16h MM@25C vs WT MM-4h_transfer from 16h MM@25C[13990062]
7	GSM841744	WT MM-4h_transfer from 16h MM@25C vs xlr-1 MM-4h_transfer from 16h MM@25C[13769160]
8	GSM841745	xlr-1 Avicel-4h_transfer from 16h MM@25C vs WT Avicel-4h_transfer from 16h MM@25C[13790881]
9	GSM841746	xlr-1 Avicel-4h_transfer from 16h MM@25C vs xlr-1 MM-4h_transfer from 16h MM@25C[13790882]
10	GSM841747	xlr-1 MM-4h_transfer from 16h MM@25C vs xlr-1 Avicel-4h_transfer from 16h MM@25C[13790883]
11	GSM841748	WT Avicel-4h_transfer from 16h MM@25C vs xlr-1 Avicel-4h_transfer from 16h MM@25C[13790872]
12	GSM841749	WT MM-4h_transfer from 16h MM@25C vs WT Xylan-4h_transfer from 16h MM@25C[13929884]
13	GSM841750	WT Xylan-4h_transfer from 16h MM@25C vs WT MM-4h_transfer from 16h MM@25C[13989800]
14	GSM841751	WT Xylan-4h_transfer from 16h MM@25C vs WT MM-4h_transfer from 16h MM@25C[13929879]
15	GSM841752	WT MM-4h_transfer from 16h MM@25C vs WT Xylan-4h_transfer from 16h MM@25C[13989825]
16	GSM841753	Xlr-1 Xylan-4h_transfer from 16h MM@25C vs WT Xylan-4h_transfer from 16h MM@25C[13791355]

17	GSM841754	WT Xylan-4h_transfer from 16h MM@25C vs xlr-1 Xylan-4h_transfer from 16h MM@25C[13791357]
18	GSM841755	xlr-1 MM-4h_transfer from 16h MM@25C vs xlr-1 Xylan-4h_transfer from 16h MM@25C[13790884]
19	GSM841756	xlr-1 Xylan-4h_transfer from 16h MM@25C vs xlr-1 MM-4h_transfer from 16h MM@25C[13791354]
20	GSM841757	WT MM-4h_transfer from 16h MM@25C vs WT Xylose-4h_transfer from 16h MM@25C[14104534]
21	GSM841758	WT Xylose-4h_transfer from 16h MM@25C vs WT MM-4h_transfer from 16h MM@25C[14104535]
22	GSM841759	xlr-1 MM-4h_transfer from 16h MM@25C vs xlr-1 Xylose-4h_transfer from 16h MM@25C[14104536]
23	GSM841760	xlr-1 Xylose-4h_transfer from 16h MM@25C vs xlr-1 MM-4h_transfer from 16h MM@25C[14104537]

Table 2 — Grouped experimental samples

Wild type (11 samples)

S. No.	Accession	Title
1	GSM841738	WT Avicel-4h_transfer from 16h MM@25C vs WT MM-4h_transfer from 16h MM@25C[13927384]
2	GSM841739	WT MM-4h_transfer from 16h MM@25C vs WT Avicel-4h_transfer from 16h MM@25C[13927383]
3	GSM841740	WT MM-4h_transfer from 16h MM@25C vs WT Avicel-4h_transfer from 16h MM@25C[13927193]
4	GSM841741	WT Avicel-4h_transfer from 16h MM@25C vs WT MM-4h_transfer from 16h MM@25C[13927197]
5	GSM841742	WT MM-4h_transfer from 16h MM@25C vs WT Avicel-4h_transfer from 16h MM@25C[13929871]
6	GSM841749	WT MM-4h_transfer from 16h MM@25C vs WT Xylan-4h_transfer from 16h MM@25C[13929884]
7	GSM841750	WT Xylan-4h_transfer from 16h MM@25C vs WT MM-4h_transfer from 16h MM@25C[13989800]
8	GSM841751	WT Xylan-4h_transfer from 16h MM@25C vs WT MM-4h_transfer from 16h MM@25C[13929879]
9	GSM841752	WT MM-4h_transfer from 16h MM@25C vs WT Xylan-4h_transfer from 16h MM@25C[13989825]
10	GSM841757	WT MM-4h_transfer from 16h MM@25C vs WT Xylose-4h_transfer from 16h MM@25C[14104534]
11	GSM841758	WT Xylose-4h_transfer from 16h MM@25C vs WT MM-4h_transfer from 16h MM@25C[14104535]

xlr-1 gene deletion mutant vs. wild type (12 samples)

1	GSM841743	xlr-1 MM-4h_transfer from 16h MM@25C vs WT MM-4h_transfer from 16h MM@25C[13990062]
2	GSM841744	WT MM-4h_transfer from 16h MM@25C vs xlr-1 MM-4h_transfer from 16h MM@25C[13769160]
3	GSM841745	xlr-1 Avicel-4h_transfer from 16h MM@25C vs WT Avicel-4h_transfer from 16h MM@25C[13790881]
4	GSM841746	xlr-1 Avicel-4h_transfer from 16h MM@25C vs xlr-1 MM-4h_transfer from 16h MM@25C[13790882]
5	GSM841747	xlr-1 MM-4h_transfer from 16h MM@25C vs xlr-1 Avicel-4h_transfer from 16h MM@25C[13790883]
6	GSM841748	WT Avicel-4h_transfer from 16h MM@25C vs xlr-1 Avicel-4h_transfer from 16h MM@25C[13790872]
7	GSM841753	Xlr-1 Xylan-4h_transfer from 16h MM@25C vs WT Xylan-4h_transfer from 16h MM@25C[13791355]
8	GSM841754	WT Xylan-4h_transfer from 16h MM@25C vs xlr-1 Xylan-4h_transfer from 16h MM@25C[13791357]
9	GSM841755	xlr-1 MM-4h_transfer from 16h MM@25C vs xlr-1 Xylan-4h_transfer from 16h MM@25C[13790884]
10	GSM841756	xlr-1 Xylan-4h_transfer from 16h MM@25C vs xlr-1 MM-4h_transfer from 16h MM@25C[13791354]
11	GSM841759	xlr-1 MM-4h_transfer from 16h MM@25C vs xlr-1 Xylose-4h_transfer from 16h MM@25C[14104536]
12	GSM841760	xlr-1 Xylose-4h_transfer from 16h MM@25C vs xlr-1 MM-4h_transfer from 16h MM@25C[14104537]

Table 3 — Gene refinement report

Up-regulated genes	Logfold values 111.2323907 to 1.0006875 = 167 genes
No. of genes bearing positive logFC values	Logfold values above 0.9949901 to 0.0000192 = 919 genes
	Total (167+919) = 1,086 genes
No. of genes bearing zero logFC values	74 genes
Down-regulated genes	Logfold values -0.0003408 to -16.517224 = 3,560 genes
No. of genes bearing negative logFC values	

Table 4 — Secreted gene abundance plot data

S. No	Gene description	Abundance
1	Carboxyl terminus of HSC70-interacting protein	379
2	2b protein	60
3	Replication protein 2a	60
4	MFS transporter	24
5	Integral membrane protein	17
6	Oxidoreductase	15
7	WD domain-containing protein	9
8	Monooxygenase	9
9	C2H2 finger domain-containing protein	8
10	WD repeat protein	8
11	Ser/Thr protein phosphatase	8
12	ABC transporter	8
13	MFS multidrug transporter	8
14	Mitochondrial carrier protein	8
15	Methyltransferase	7
16	Ubiquitin C-terminal hydrolase	7
17	Short chain dehydrogenase/reductase	7
18	Kinesin	7
19	Phosphoglycerate mutase	6
20	Pre-mrna splicing factor	6
21	Glycosyl hydrolase	6
22	Thioredoxin	6
23	Hydrolase	6
24	SH3 domain-containing protein	6
25	F-box domain-containing protein	6
26	Triacylglycerol lipase	5
27	Membrane transporter	5
28	Amidohydrolase	5
29	Aldehyde dehydrogenase	5
30	Acetyltransferase	5
31	Short chain dehydrogenase	5
32	Dienelactone hydrolase	5
33	3-oxoacyl-(acyl-carrier-protein) reductase	5
34	Dnaj domain-containing protein	5
35	Eukaryotic translation initiation factor 3	4
36	MFS monocarboxylate transporter	4
37	3' exoribonuclease 4	4
38	Epoxide hydrolase	4
39	DNA-directed RNA polymerase II polypeptide	4
40	Phenol 2-monooxygenase	4
41	Nitrilase	4
42	C6 finger domain-containing protein	4
43	Questionable protein	4
44	C2H2 transcription factor	4
45	Alpha/beta hydrolase	4
46	Ribosome biogenesis protein	4
47	NAD dependent epimerase/dehydratase	4
48	PH domain-containing protein	4
49	DUF221 domain-containing protein	4
50	RNA binding protein	4
51	Thioesterase	4
52	FAD dependent oxidoreductase	4

53	Cupin domain-containing protein	4
54	RTA1 domain-containing protein	4
55	Short-chain dehydrogenase/reductase SDR	4
56	D-lactate dehydrogenase	4
57	Chitin deacetylase	4
58	Sugar transporter	4

Table 5 — Top 10% abundantly secreted genes

S. No.	Gene ID	logFC	Gene Description
1	NCU08398.2	83.5031991	aldose 1-epimerase
2	NCU03181.2	28.004884	acetylxylan esterase
3	NCU00985.2	18.9534771	hydrolase
4	ChIP_Chip_239	12.512583	carboxyl terminus of HSC70-interacting protein
5	NCU05159.2	9.3119136	acetylxylan esterase
6	ChIP_Chip_361	7.7723636	carboxyl terminus of HSC70-interacting protein
7	NCU00988.2	6.6755544	MFS quinate transporter
8	NCU09051.2b	6.1481464	2b protein
9	NCU08516.2	5.7275848	aldose 1-epimerase
10	NCU06009.2	5.6678656	oxidoreductase
11	ChIP_Chip_339	5.3920422	carboxyl terminus of HSC70-interacting protein
12	NCU08750.2	4.6660409	isoamyl alcohol oxidase
13	NCU02097.2	4.3794142	short chain dehydrogenase
14	NCU09664.2	3.8939206	acetylxylan esterase
15	NCU05887.2	3.5658541	oxidoreductase
16	ChIP_Chip_135	3.4028258	carboxyl terminus of HSC70-interacting protein
17	NCU08361.2	3.2100916	short chain dehydrogenase
18	ChIP_Chip_93	2.7838484	carboxyl terminus of HSC70-interacting protein
19	ChIP_Chip_318	2.69447	carboxyl terminus of HSC70-interacting protein
20	NCU08428.2	2.6419575	MFS transporter
21	ChIP_Chip_156	2.5582795	carboxyl terminus of HSC70-interacting protein
22	NCU00710.2	2.5260563	acetyl xylan esterase
23	NCU09027.2	2.3866394	MFS transporter
24	NCU10584.2a	2.0988983	replication protein 2a
25	NCU09287.2	2.0678121	sugar transporter
26	NCU04870.2	2.0211084	acetyl xylan esterase
27	NCU05585.2	1.8733308	MFS quinate transporter
28	NCU07890.2a	1.8380436	replication protein 2a
29	ChIP_Chip_367	1.8007576	carboxyl terminus of HSC70-interacting protein
30	NCU09654.2	1.7953261	MFS transporter
31	ChIP_Chip_341	1.5997751	carboxyl terminus of HSC70-interacting protein
32	ChIP_Chip_344	1.5577401	carboxyl terminus of HSC70-interacting protein
33	ChIP_Chip_196	1.4600465	carboxyl terminus of HSC70-interacting protein
34	ChIP_Chip_17	1.4462126	carboxyl terminus of HSC70-interacting protein
35	ChIP_Chip_60	1.4108703	carboxyl terminus of HSC70-interacting protein
36	ChIP_Chip_271	1.3545185	carboxyl terminus of HSC70-interacting protein
37	ChIP_Chip_138	1.2380177	carboxyl terminus of HSC70-interacting protein
38	ChIP_Chip_75	1.1925338	carboxyl terminus of HSC70-interacting protein
39	ChIP_Chip_211	1.1580679	carboxyl terminus of HSC70-interacting protein
40	NCU09648.2	1.1517974	aldehyde dehydrogenase
41	NCU00828.2	1.1128265	peroxisomal membrane protein
42	NCU02188.2	1.1007459	sugar transporter
43	ChIP_Chip_368	1.0598052	carboxyl terminus of HSC70-interacting protein
44	ChIP_Chip_148	1.0533553	carboxyl terminus of HSC70-interacting protein
45	ChIP_Chip_175	0.9949901	carboxyl terminus of HSC70-interacting protein
46	NCU07668.2	0.9688385	MFS multidrug transporter
47	NCU05475.2b	0.9155631	2b protein
48	ChIP_Chip_264	0.9059428	carboxyl terminus of HSC70-interacting protein
49	NCU05390.2zz30	0.8514834	mitochondrial phosphate carrier protein

50	NCU10535.2b	0.8366839	2b protein
51	NCU07915.2	0.8354989	integral membrane protein
52	ChIP_Chip_248	0.8289127	carboxyl terminus of HSC70-interacting protein
53	NCU00195.2	0.8237132	MFS transporter
54	ChIP_Chip_4	0.8040315	carboxyl terminus of HSC70-interacting protein
55	ChIP_Chip_125	0.7974141	carboxyl terminus of HSC70-interacting protein
56	NCU00829.2	0.7866593	ferric reductase
57	ChIP_Chip_3	0.7851156	carboxyl terminus of HSC70-interacting protein
58	NCU07607.2	0.7625716	sugar transporter
59	NCU05390.2	0.7487579	mitochondrial phosphate carrier protein
60	ChIP_Chip_20	0.6871866	carboxyl terminus of HSC70-interacting protein
61	ChIP_Chip_84	0.6776215	carboxyl terminus of HSC70-interacting protein
62	ChIP_Chip_235	0.6682185	carboxyl terminus of HSC70-interacting protein
63	ChIP_Chip_197	0.6667857	carboxyl terminus of HSC70-interacting protein
64	ChIP_Chip_210	0.6114018	carboxyl terminus of HSC70-interacting protein
65	NCU01275.2	0.5719339	oxidoreductase
66	NCU09507.2a	0.5634676	replication protein 2a
67	NCU05394.2	0.544621	MFS transporter
68	NCU00821.2	0.5191966	sugar transporter
69	ChIP_Chip_212	0.4945076	carboxyl terminus of HSC70-interacting protein
70	ChIP_Chip_183	0.4905407	carboxyl terminus of HSC70-interacting protein
71	NCU07256.2a	0.4728873	replication protein 2a
72	ChIP_Chip_143	0.4444988	carboxyl terminus of HSC70-interacting protein
73	NCU07598.2a	0.4433784	replication protein 2a
74	ChIP_Chip_349	0.4316098	carboxyl terminus of HSC70-interacting protein
75	NCU00023.2	0.4239448	ferric reductase
76	ChIP_Chip_287	0.4222581	carboxyl terminus of HSC70-interacting protein
77	ChIP_Chip_288	0.4134777	carboxyl terminus of HSC70-interacting protein
78	NCU03995.2	0.402656	oligosaccharyl transferase subunit
79	NCU00669.2	0.378378	oligosaccharyl transferase subunit
80	ChIP_Chip_142	0.3735518	carboxyl terminus of HSC70-interacting protein
81	ChIP_Chip_160	0.3618238	carboxyl terminus of HSC70-interacting protein
82	NCU04494.2	0.3616834	acetyl xylan esterase
83	ChIP_Chip_177	0.357286	carboxyl terminus of HSC70-interacting protein
84	ChIP_Chip_372	0.3569046	carboxyl terminus of HSC70-interacting protein
85	NCU00983.2	0.3556736	integral membrane protein
86	ChIP_Chip_369	0.3519644	carboxyl terminus of HSC70-interacting protein
87	ChIP_Chip_106	0.3387764	carboxyl terminus of HSC70-interacting protein
88	NCU03618.2	0.3222992	integral membrane protein
89	NCU04108.2	0.3212842	isoamyl alcohol oxidase
90	ChIP_Chip_380	0.3154287	carboxyl terminus of HSC70-interacting protein
91	NCU06061.2	0.3037535	oxidoreductase
92	NCU01302.2	0.2936706	hydrolase
93	NCU09655.2b	0.2823354	2b protein
94	ChIP_Chip_55	0.2808405	carboxyl terminus of HSC70-interacting protein
95	NCU08659.2b	0.2802504	2b protein
96	ChIP_Chip_38	0.2794143	carboxyl terminus of HSC70-interacting protein
97	NCU09763.2b	0.2777054	2b protein
98	ChIP_Chip_263	0.264405	carboxyl terminus of HSC70-interacting protein
99	NCU05207.2b	0.2615803	MFS multidrug transporter
100	NCU00378.2	0.2528931	aldehyde dehydrogenase
101	ChIP_Chip_171	0.2492274	carboxyl terminus of HSC70-interacting protein
102	ChIP_Chip_189	0.245234	carboxyl terminus of HSC70-interacting protein
103	NCU03151.2	0.2413305	peroxisomal membrane protein
104	ChIP_Chip_51	0.2375128	carboxyl terminus of HSC70-interacting protein
105	ChIP_Chip_376	0.2340946	carboxyl terminus of HSC70-interacting protein
106	ChIP_Chip_297	0.2327128	carboxyl terminus of HSC70-interacting protein
107	NCU10984.2b	0.2316651	2b protein
108	ChIP_Chip_191	0.2307027	carboxyl terminus of HSC70-interacting protein
109	ChIP_Chip_140	0.2290091	carboxyl terminus of HSC70-interacting protein
110	NCU09286.2b	0.227701	2b protein

111	NCU08407.2a	0.2236309	MFS transporter
112	NCU01364.2	0.2227611	oxidoreductase
113	ChIP_Chip_139	0.2164741	carboxyl terminus of HSC70-interacting protein

Table 6 — Frequency of gene repeats ranked among the top 10% of abundantly secreted genes, used as the input list for PIN construction

Gene Description	Repeats rank
carboxyl terminus of HSC70-interacting protein	54
2b protein	8
MFS transporter	6
oxidoreductase	5
replication protein 2a	5
sugar transporter	4
acetyl xylan esterase	3
acetyl xylan esterase	3
integral membrane protein	3
aldose 1-epimerase	2
hydrolase	2
MFS quinate transporter	2
isoamyl alcohol oxidase	2
short chain dehydrogenase	2
aldehyde dehydrogenase	2
peroxisomal membrane protein	2
MFS multidrug transporter	2
mitochondrial phosphate carrier protein	2
ferric reductase	2
oligosaccharyl transferase subunit	2

Table 7 — Parametric layout implied output gene list

S. No	Grid genes		
1	A7UVV2	25	pex19
2	ti	26	Q7S869
3	pph-1	27	pex12
4	cmd-1	28	pex3
5	act	29	pex16
6	cnb-1	30	pex10
7	cna-1	31	pex-6
8	Q7RXI8	32	pex5
9	Q7S6V7	33	pex11
10	Q7S7P2	34	F5H9K1
11	mtp-2	35	fox-2
12	smco-1	36	pex7
13	pex13	37	Q7SAN8
14	Q7SHS3	38	flkr-3
15	Q7SHY4	39	Q7RZ32
16	pph-3	40	gal-7
17	rgb-1	41	gh2-2
18	A7UW84	42	Q7RZQ9
19	Q1K6C9	43	Q7S0R2
20	gh31-2	44	Q7S6X8
21	Q9C2M6	45	Q7S2S1
22	gh63-1	46	Q7S932
23	Dynamamin-1	47	Q7S9P8
24	pex14	48	pex1

Table 8 — Genes visualized in Cytoscape software 3.9.1

S. No.	Overall network genes	Subnetwork 1 - genes	Subnetwork 2 - genes
1	pex7	Dynamin-1	A7UW84
2	pex10	mtp-2	Q7SHY4
3	pex-6	act	ti
4	pex3	cmd-1	Q7SHS3
5	pex12	pph-3	Q9C2M6
6	pex16	Q7S869	gh63-1
7	pex19	Q7S6V7	Q7RXI8
8	pex13	myo2	Q1K6C9
9	pex11	tpm	EFNCRP00000005613
10	fox-2	pph-1	gh31-2
11	pex14	pex14	
12	pex5	pex11	
13	Q7SAN8	EFNCRP00000006289	
14	gh2-2	Q7S2S1	
15	Q7S2S1	Q7S7P2	
16	gal-7	cna-1	
17	Q7S869	pex13	
18	Q7RZ32	pex19	
19	EFNCRP00000006771	pex16	
20	yth-1	pex12	
21	ssu-72	pex3	
22	paa-3	rgb-1	
23	paa-1	fkr-3	
24	EFNCRP00000006619	EFNCRP00000003445	
25	pph-3	pex5	
26	EFNCRP00000006498	rrd-2	
27	gh31-2	EFNCRP00000000913	
28	EFNCRP00000005613	EFNCRP00000003800	
29	cna-1	smco-1	
30	Q7S932	A7UVV2	
31	cmd-1	Q7S932	
32	EFNCRP00000006289	Q7SAN8	
33	smco-1	fox-2	
34	EFNCRP00000003445	Cofilin	
35	fkr-3	fim	
36	Q7S6V7	Profilin	
37	EFNCRP00000003800	EFNCRP00000000488	
38	EFNCRP00000000913	EFNCRP00000006498	
39	EFNCRP00000000488	EFNCRP00000006619	
40	mtp-2	paa-1	
41	Dynamin-1	paa-3	
42	act	ssu-72	
43	Profilin	yth-1	
44	fim	EFNCRP00000006771	
45	tpm	Q7RZ32	
46	EFNCRP00000007408	gal-7	
47	myo2	gh2-2	
48	Cofilin	pex-6	
49	Q1K6C9	pex10	
50	Q7RXI8	pex7	
51	gh63-1	EFNCRP00000007408	
52	Q9C2M6		
53	Q7SHS3		
54	ti		
55	Q7SHY4		
56	A7UW84		
57	pph-1		
58	rrd-2		

59	rgb-1
60	Q7S7P2
61	A7UUVV2

Table 9 — Network analyzer statistical summary data of subnetwork 1 and subnetwork 2

Parameters	Subnetwork 1	Subnetwork 2
Number of nodes	51	10
Number of edges	166	31
Average number of neighbors	6.51	6.2
Network diameter	8	3
Network radius	4	2
Characteristic path length	4.061	1.333
Clustering coefficient	0.684	0.879
Network density	0.13	0.689
Network heterogeneity	0.477	0.313
Network centralization	0.114	0.25
Connected components	1	1
Analysis time (sec)	0.047	0.343

Table 10 — Gene annotation retrieval data from UniProt

Protein/gene	Uniprot ID	Annotation
EFNCRP00000007408	Q7SF15	WASP-like protein las17p
gh63-1	V5IM04_NEUCR	Mannosyl-oligosaccharide glucosidase
EFNCRP00000006498	Q7SD66_NEUCR	Phosphatase PP1 regulatory subunit sds22
gh2-2	Q7S1W5_NEUCR	Beta-galactosidase
EFNCRP00000005613	Q7S6V9_NEUCR	Glucosidase-2 subunit beta
