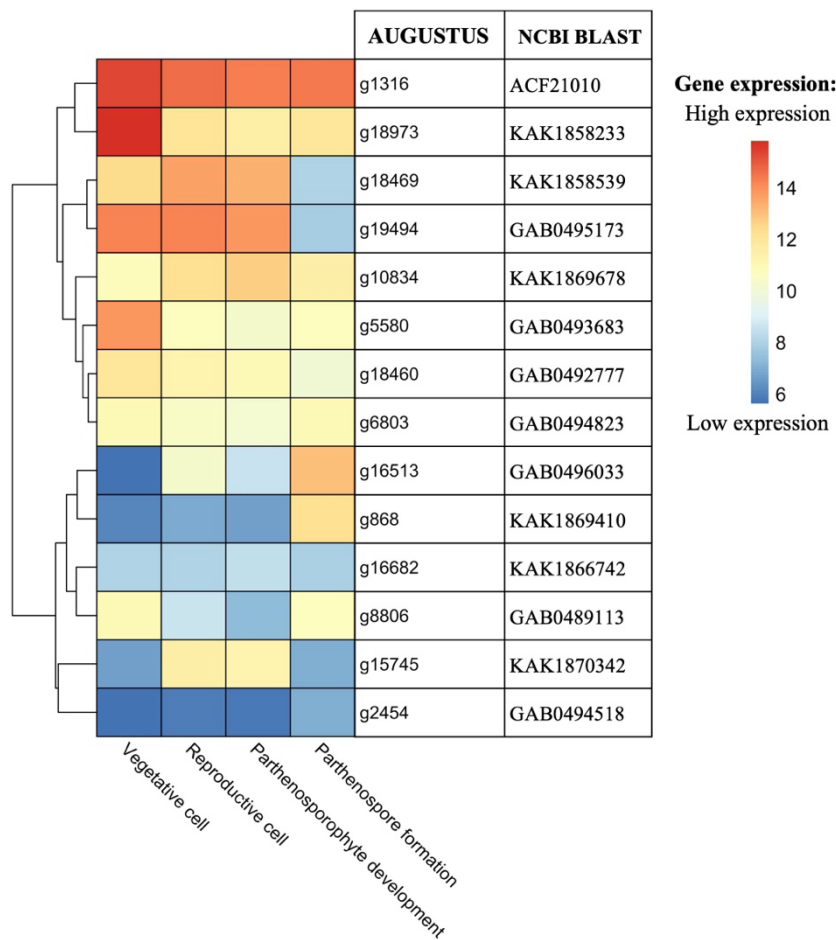


Supplementary material



Supplementary Figure 1. Heatmap showing variance-stabilized expression levels of peroxidase-annotated genes across developmental stages of *Pyropia haitanensis*. Expression values were obtained using the DESeq2 variance-stabilizing transformation (VST) and are shown without additional scaling. Rows represent genes and columns represent developmental stages (mean expression across biological replicates). Colour intensity reflects absolute, variance-stabilized expression magnitude. This heatmap illustrates overall expression levels and between-gene differences, in contrast to the Z-score-normalized heatmap used to visualize relative stage-specific expression patterns.

	Reproductive cell development stage			Parthenospore development stage			Parthenosporophyte formation stage		
Gene	log2FoldChange	padj	Regulation	log2FoldChange	padj	Regulation	log2FoldChange	padj	Regulation
g10834	1.55	3.76E-07	Upregulated	1.97	3.82E-12	Upregulated	0.81	3.12E-04	Upregulated
g1316	-0.73	6.56E-03	Downregulated	-1.04	5.37E-03	Downregulated	-0.90	8.88E-05	Downregulated
g15745	6.61	2.76E-94	Upregulated	6.33	5.39E-61	Upregulated	0.97	2.92E-01	Not significant
g16513	12.40	5.86E-23	Upregulated	10.36	1.60E-15	Upregulated	15.28	9.45E-36	Upregulated
g16682	0.00	9.96E-01	Not significant	0.62	1.39E-01	Not significant	0.00	9.92E-01	Not significant
g18460	-0.79	3.30E-04	Downregulated	-1.14	1.26E-05	Downregulated	-1.95	2.56E-14	Downregulated
g18469	1.20	8.92E-08	Upregulated	0.98	3.50E-03	Upregulated	-4.82	8.43E-58	Downregulated
g18973	-3.76	1.82E-51	Downregulated	-4.22	3.93E-27	Downregulated	-3.85	4.75E-61	Downregulated
g19494	-0.02	9.59E-01	Not significant	-0.45	1.92E-01	Not significant	-6.83	1.14E-15	Downregulated
g2454	3.69	4.27E-01	Not significant	2.64	NA	Not significant	7.78	2.52E-07	Upregulated
g5580	-3.24	3.67E-33	Downregulated	-3.62	1.02E-35	Downregulated	-3.20	2.01E-59	Downregulated
g6803	-0.59	3.32E-02	Downregulated	-0.91	3.38E-03	Downregulated	-0.02	9.48E-01	Not significant
g868	3.04	6.61E-04	Upregulated	2.49	1.73E-02	Upregulated	10.10	2.30E-94	Upregulated
g8806	-2.56	9.15E-10	Downregulated	-4.50	1.37E-25	Downregulated	-0.29	2.25E-01	Not significant

Supplementary Table 1. Differential expression statistics for peroxidase-annotated genes across developmental stage comparisons relative to the vegetative cell proliferation stage in *Pyropia haitanensis*. Differential expression analysis was performed using DESeq2 on raw count data. For each gene, log2 fold changes, Benjamini–Hochberg adjusted p-values (padj), and inferred regulation status are shown for pairwise contrasts between the vegetative stage and the reproductive cell development stage, parthenosporophyte formation stage, and parthenospore development stage. Positive log2 fold change values indicate higher expression relative to the vegetative stage, whereas negative values indicate lower expression. Statistical significance was assessed using Wald tests with an adjusted p-value threshold of 0.05. Genes with NA adjusted p-values did not pass DESeq2 independent filtering or lacked sufficient counts for reliable statistical testing.