**SUPPLEMENTAL INFORMATION**

Fig S1. Maximum likelihood tree (ln = -8051.23052) of cyanase from parasitic nematodes, bacteria, fungi and plants. The tree was rooted using *Synechococcus*, the taxon closest to the midpoint of the tree. Cyanase from clade I parasitic nematodes (*Trichinella, Trichuris* and *Soboliphyme* species) form a monophyletic clade sister to plant cyanases and more closely related to fungal cyanases than to bacterial cyanases. Cyanases from clade III and IV parasitic nematodes cluster within bacterial cyanases; intervening bacterial sequences within this group suggest more than one independent acquisition of cyanase within clades III and IV parasitic nematodes. Node support is indicated as probability based on chi-squared approximations of the likelihood ratio. The tree presented is based on the Dayhoff amino acid substitution model, but the topology of the tree was robust to the substitution model.

Fig S2. Aligning amino acid sequences within the putative active site revealed that the *T. spiralis* cyanase harbored all the key amino acids characteristic of an operational protein.

Table S1. List of all organisms, accessions numbers and sequence lengths used in the alignment of cyanase and in the phylogenetic analyses.

Table S2. List of all nematodes harboring cyanase homologues. Included in the table are those which also possess carbamoyl phosphate synthetase 1 and 2 (CPS-1 & -2), the CAD protein and individual components of the CAD protein. CAD is a trifunctional, multi-domain enzyme involved in the first three steps of pyrimidine biosynthesis and consists of CPS-2 (C), aspartate transcarbamylase (A; ATCase) and dihydroorotase (D). All three enzymes are required in the canonical, de-novo synthesis of pyrimidines. De-novo synthesis starts with cytosolic carbamoyl phosphate synthetase 2 which uses glutamine, carbon dioxide and ATP. The term “Clade” refers to a phylogenetic classification system for the Phylum Nematoda wherein Clade I nematodes are ancestral and form the base of the phylogenetic tree and Clade 5 nematodes are more recently evolved and appear at the crown of the tree.