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ANÁLISE EVOLUTIVA DAS FITOCISTATINAS NA LINHAGEM VEGETAL

PATOS DE MINAS – MG
DEZEMBRO DE 2019

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Orientador: Prof. Dr. Aulus Estevão Anjos de Deus Barbosa

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RESUMO

Cistatinas são proteínas inibidoras de proteases cisteínicas C1 e C13, que atuam por meio da sua ligação reversível no sítio ativo das proteases. As fitocistatinas (PhyCys) apresentam potencial para o controle de pragas, resistência ambiental para cultivares e na nutracêutica. Tendo em vista a importância das PhyCys, o trabalho teve como objetivo realizar a análise evolutiva *in silico* destas proteínas na linhagem vegetal, buscando por cistatinas em algas, algas verdes, briófitas e pteridófitas. Para as análises foram criados bancos de dados de proteínas codificadas pelos genomas de 416 espécies de algas, algas verdes, briófitas e pteridófitas obtidas no banco de dados *1000 Plants*. Foi utilizado a ferramenta blastp junto ao programa Blast2GO para identificar as sequências de cistatinas presentes nos bancos de dados, foi realizada também a identificação dos domínios conservados. E com auxílio do programa MEGAX foi realizado o alinhamento das sequências encontradas com a ferramenta MUSCLE e a construção das árvores filogenéticas. Foram preditas 36 PhyCys em algas verdes, 144 em briófitas e 68 em pteridófitas, com os aminoácidos GG, LAxFAV-HN, QVVxG, YEAKVWxPWE e F conversados entre elas. Já as árvores filogenéticas indicaram pouca correlação entre as PhyCys encontradas com as observadas em plantas superiores, desta forma não foi possível classificá-las usando a classificação conhecida de PhyCys. Isto indica a necessidade de uma nova classificação para esse grupo de inibidores, incluindo estes genes identificados em plantas mais primitivas.

Palavras-chave: Cistatinas. Evolução das fitocistatinas. Algas verdes, briófitas e pteridófitas.

ABSTRACT

Cystatins are C1 and C13 cysteine protease inhibitor proteins that act by their reversible binding in the active site of the proteases. Phytocystatins have potential for pest control, environmental resistance to cultivars and in nutraceutica. Given the importance of phytocystatins, the objective of this work was to carry out an in silico evolutionary analysis of these proteins in the plant lineage, searching for cystatins in algae, green algae, bryophytes and pteridophytes. Protein databases encoded by the genomes of 416 species of algae, green algae, bryophytes and pteridophytes obtained from 1000 Plants database, were created for the analyzes. The blastp tool was used along with Blast2GO program to identify the cystatin sequences present in the databases. The conserved domains were also identified. And with MEGAX program, the alignment of the sequences was made using the MUSCLE tool and the construction of phylogenetic trees were performed. Was predicted 36 phytocystatins in green algae, 144 in bryophytes and 68 in pteridophytes, with the amino acids GG, LAxFAV-HN, QVVxG, YEAKVWxPWE and F conversed between them. Phylogenetic trees, indicated a small correlation between phytocystatins found with those observed in higher plants, so it was not possible to classify them using the known phytocystatins classification. This indicates the need for a new classification for this group of inhibitors, including these genes identified in primitive plants.

Keywords: Cystatins. Phytocystatins evolution. Green algae, bryophytes and pteridophytes.

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1 INTRODUÇÃO

As fitocistatinas (PhyCys) são proteínas inibidoras de proteases semelhantes a papaína (C1) e legumaina (C13), que apresentam potencial para diversas aplicações biotecnológicas. As proteases cisteínicas (CysProt) estão envolvidas em vários processos fisiológicos nas plantas, como no processamento pós-traducional, morte celular programada e senescência (GRUIS; SCHULZE; JUNG, 2004; MÜNTZ; SHUTOV, 2002; MURAMATSU; FUKAZAWA, 1993; SOLOMON et al., 1999; UEDA et al., 2000). Uma das suas principais aplicações são em plantas transgênicas resistentes a pragas, por meio da inibição das proteases exógenas, reduzindo a sobrevivência das pragas e o aumento da resistência ao estresse ambiental (CHAUHAN; JASRAI; PANDYA, 2015; MARGIS; REIS; VILLERET, 1998; MARTÍNEZ et al., 2012; SCHLÜTER et al., 2010; SIMOVA-STOILOVA et al., 2010).

A busca por avanços na biotecnologia tem um papel fundamental na produção agrícola, aumentando a produção de alimentos diversificados e nutritivos de forma mais barata devido ao aumento da eficiência da produção (HAN et al., 2015; ISMAEL; BENNETT; MORSE, 2002; RANEY, 2006; TIMMIS et al., 2017). Além do potencial econômico da biotecnologia, com os efeitos das mudanças climáticas e adaptação das pragas às tecnologias já existentes, torna-se necessário a busca por novas alternativas para o melhoramento da produção (JURY; VAUX, 2007; MOURTZINIS et al., 2015).

Em vista da sua importância, a utilização de PhyCys já descritas aliada ao o uso de bancos de dados públicos de genomas e ferramentas de bioinformática, é possível a realização do estudo evolutivo das PhyCys na linhagem vegetal, contribuindo para a melhor compreensão da sua evolução, identificação de novas PhyCys e avanços na sua pesquisa.

2 REFERENCIAL TEÓRICO

2.1 Evolução das plantas

As algas verdes podem ter se originado a aproximadamente 1500 a 1200 Ma (BUTTERFIELD, 2000; YOON et al., 2004), e apresentam duas principais grandes linhagens, charophyta e chlorophyta, que podem ter se divergido a cerca de ~1000 Ma, sendo charophytas praticamente exclusivas de água doce (DELAUX et al., 2012; YOON et al., 2004). As algas verdes estão presentes em diversos habitats, como superfície da neve, troncos de árvores e no solo em associação com fungos (RAVEN; EVERT; EICHHORN, 2013). Estima-se que as plantas terrestres se originaram a cerca de ~470 Ma a partir da linhagem charophyta (streptophyta), passando por processos de adaptação junto ao bioma terrestre microbiano diverso, dando origem a parede celular baseada em polissacarídeos, desenvolvimento da maquinaria fotossintética, resistência à desidratação, e transição para o ciclo de vida de haplodiplonte, dessa forma originando as briófitas e plantas vasculares (BOWER, 2011; HARHOLT; MOESTRUP; ULVSKOV, 2016; WELLMAN; STROTHER, 2015). Várias características indicam a semelhança das algas verdes com briófitas, pteridófitas e plantas vasculares: são os únicos grupos com clorofila a e b, apresentam armazenamento de amido nos cloroplastos, parede celular rígida, estrutura reprodutiva semelhante, assim como dados moleculares como dados genômicos (RAVEN; EVERT; EICHHORN, 2013).

As briófitas antóceros *(hornworts)*, hepáticas (*liverworts)* e musgos (*mosses)*, são pequenas plantas sem tecido vascular (xilema e floema), que crescem em locais úmidos em florestas tropicais, temperadas e rochas expostas. Além disso podem ser plantas dominantes em algumas regiões como norte do Círculo Ártico, encostas rochosas e montanhas acima do limite de crescimento das árvores. Nas briófitas os esporófitos são ligados ao gametófito parental. Algumas características importantes surgiram em briófitas, como substância semelhante a cutícula cerosa das plantas vasculares, estômatos e esporófito persistente. Já outras características como esporófito ramificado independente e tecido vascular vão se relacionar as primeiras plantas vasculares (RAVEN; EVERT; EICHHORN, 2013).

A origem das plantas vasculares, licófitas *(lycophytes)*, monilófitas (*monilophytes)* e espermatófitas (*spermatophytes*), está relacionada ao desenvolvimento do xilema e floema, e a capacidade de sintetizar lignina para sustentar estes tecidos condutores e o crescimento da planta, possibilitando que atinjam maior altura. Outra característica importante, é a capacidade de se ramificar por meio dos meristemas apicais e presença de esporófito de vida livre.

Às adaptações das plantas possibilitaram que estas dominassem os habitats terrestres por volta de 408 a 362 milhões de anos. Briófitas e plantas vasculares se estabeleceram no ambiente terrestre (BATEMAN et al., 1998; BOWMAN, 2013; KENRICK; CRANE, 1997; RAVEN; EVERT; EICHHORN, 2013) e causaram mudanças drásticas no clima, solo e na produção primária na cadeia alimentar, além de possibilitarem a agricultura, produção de produtos de usos industriais diversos, assim como metabólitos secundários (DAHL et al., 2010; EDWARDS; KENRICK, 2015; KUMP, 2014; LENTON et al., 2012; PORADA et al., 2014; STOCKMANN et al., 2013).

2.2 Cistatinas

Cistatinas são membros da superfamília de proteínas inibidoras de CysProt semelhantes a papaína (C1) e legumaina (C13). Esta superfamília é composta por 3 famílias principais stefina, cistatina e kininogenina, classificadas a partir da homologia, presença de glicosilação, peptídeo sinal, massa molecular e ligações de sulfeto (CORNWALL; HSIA, 2003; FEITERS; MEYER-KLAUCKE, 2013; JOSIAH OCHIENG; GAUTAM CHAUDHURI, 2010; MARTINEZ et al., 2007; NIT et al., 1997; TURK; BODE, 1991). Sua ação se dá por meio da inibição competitiva da proteína alvo (BARRETT, 1987; TURK; BODE, 1991). A superfamília apresenta resíduos glicina na porção N-terminal e motivos, QxVxG e (PA)W na porção C-terminal, onde "x" significa aminoácidos não conservados e aminoácidos entre parênteses são as variações possíveis (MARGIS; REIS; VILLERET, 1998). Cistatinas e stefinas, apresentam 4-5 fitas antiparalelas de folha-β e uma α-hélice central, onde os pontos de interação para inibição são, uma glicina conservada na extremidade N-terminal, o motivo QxVxG e um resíduo de triptofano conservado na região C-terminal. A glicina na porção N-terminal é o aminoácido que interage mais próximo ao sítio ativo da protease inibida (BARRETT, 1987; CHAUHAN; JASRAI; PANDYA, 2015; RAWLINGS; BARRETT, 1990; TURK; BODE, 1991).

As PhyCys, podem ser classificadas como uma quarta família, são homólogas a família das cistatinas, porém não apresentam ligações de sulfeto, se assemelhando às stefinas, e apresentam um motivo semelhante a LARFAVDEHN na porção N-terminal, podendo ter as variações (LVI)(AGT)(RKE)(FY)(AS)(VI)x(EDQV)(HYFQ)N (MARGIS; REIS; VILLERET, 1998; MARTINEZ et al., 2007). Na Figura 1 é possível visualizar a estrutura 3D

de uma PhyCys e a stefina A humana, e na Figura 2 é apresentado como os resíduos de aminoácidos se relacionam com a estrutura secundária da PhyCys 1 de *O. sativa*.

Membros da superfamília cistatina, apresentam diversas funções biológicas nos organismos animais e vegetais, em processos que envolvem CysProt, e podem ser encontradas nos fluidos e tecidos humanos, onde em humanos podem se relacionar com algumas patologias (BENCHABANE et al., 2010; BUTTLE; BURNETT; ABRAHAMSON, 1990; DELAISSÉ; EECKHOUT; VAES, 1984; NORTH; MOTTRAM; COOMBS, 1990; PARTHIBAN et al., 2019; SHINDO). Já proteases C1A de plantas estão relacionadas a diversos processos como, morte celular programada, acúmulo de proteínas em sementes e tubérculos, mudanças fisiológicas causadas por estresse ambiental, defesa em respostas a patógenos e ataques por pestes. Todos estes processos são passíveis de sofrer regulação por PhyCys, que apresentam ação contra proteases heterólogas e prevenção da destruição de proteínas essenciais, como proteases de patógenos e parasitas (GRUDKOWSKA; ZAGDAŃSKA, 2004; MCLELLAN et al., 2009; VAN DER HOORN, 2008; SREENIVASULU et al., 2008; WEI et al., 2019).

Figura 1. Estrutura 3D das cistatinas, PhyCys 1 de *O. sativa* (PDB – *Protein Data Bank*: 1EQK) e stefina A de *Homo sapiens* (PDB: 1CYU).

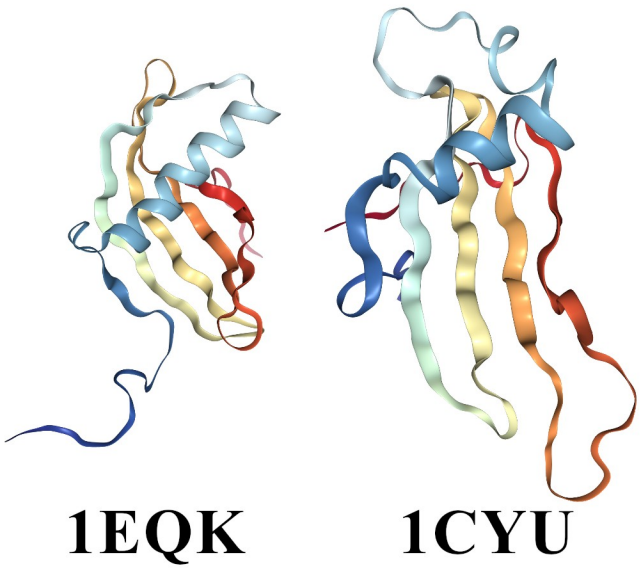
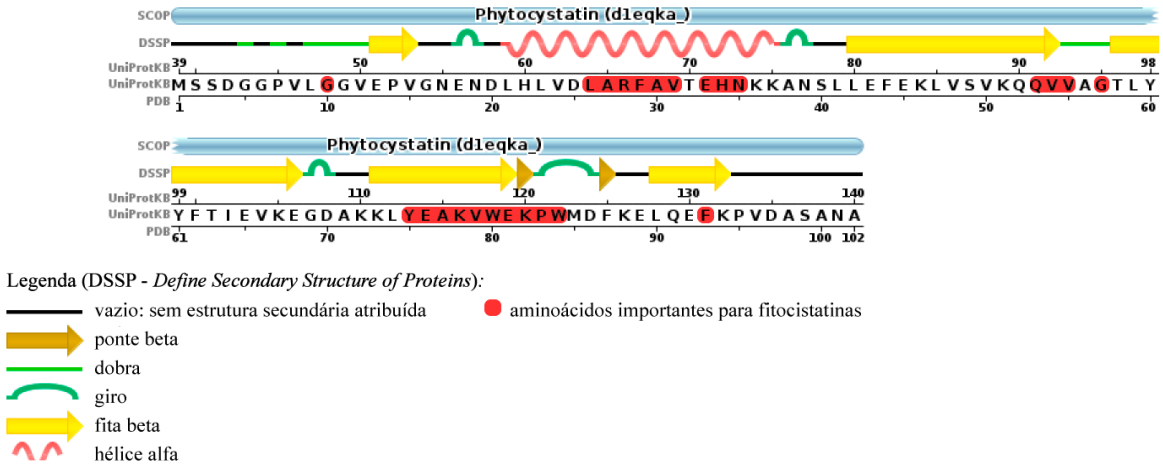


Figura 2. Estrutura secundária da PhyCys 1 de *O. sativa* (PDB: 1EQK).



Adaptado de PDB ID: 1EQK.

2.3 Importância biotecnológica das fitocistatinas

As PhyCys são proteínas consideradas seguras para consumo humano e apresentam potencial para o controle de pestes, tendo sua principal utilização no desenvolvimento de plantas transgênicas resistentes a pragas. A sua produção de maneira recombinante apresenta um grande potencial em funções como, propriedades antimicrobianas, antivirais, tratamentos de distúrbios em cistatinas humanas, aditivos alimentares e estabilizadores proteicos, e com um potencial uso em forma de *sprays* contra insetos e ácaros. Alguns genes de cistatinas superexpressos em plantas transgênicas, são OC-I e OC-II de *O. sativa.* Um dos possíveis problemas da utilização destes genes é a possível seleção de pragas resistentes. No entanto, para evitar esta resistência é possível a utilização de vários genes para defesa e a modificação de cistatinas por meio de engenharia de proteínas, o que pode oferecer novas características pesticidas ou não. Outra possível aplicação é sua utilização para mitigar os efeitos por estresse ambiental, principalmente pelo impacto do aquecimento global sobre os cultivos, por meio da mitigação da proteólise induzida por estresse e manutenção do processo fotossintético (ATKINSON; JOHNSTON; ROBBINS, 2004; KUNERT et al., 2015; MARTINEZ et al., 2016; SHAH; BANO, 2009; VAN WYK et al., 2016).

O trabalho realizado por Carrillo e colaboradores (2011) demonstrou a inibição de proteases (*cathepsin L-like* e/ou *cathepsin B-like*) dos ácaros *Tetranychus urticae* e *Brevipalpus chilensis* por meio de fitocistatinas de cevada (HvCPI) *in vitro*, na qual a cistatina

HvCPI-6 apresentou a maior inibição. Em seguida foram geradas plantas de milho transgênicas com a proteína HvCPI-6, e testes *in vitro* demonstraram prejuízo no desenvolvimento do ácaro *Tetranychus urticae.* Em outro estudo foi produzido uma planta de *Nicotiana benthamiana* transgênica contendo múltiplos genes de resistência (sporamina*,* quitinase e cistatina). A planta produzida apresentou alto nível de resistência a insetos e fitopatógenos, além de resistência a estresse abiótico (CHEN et al., 2014). Em outro trabalho foi construído uma cistatina por meio da engenharia de proteínas gerando uma cistatina com múltiplos domínios (kininogenina, stefina, cistatina C, cistatina de batata e equistatina). Foi então produzido uma planta de batata transgênica para expressar essa proteína, e demonstrou uma resistência a insetos em comparação com o controle (OUTCHKOUROV et al., 2004).

Em um estudo realizado por Leguizamón e colaboradores (2019), foi identificado efeito anti-inflamatório e pró-osteogênico de PhyCys de *Citrus sinensis*. Neste estudo a fitocistatina CsinCPI-2 foi produzida de forma recombinante, e sua atividade foi testada *in vivo* e *in vitro.* As análises para atividade anti-inflamatória demonstrando diminuição da expressão gênica das proteínas *cathepsin K*, *cathepsin B*, *IL-1β*, *TNF-α,* adicionalmente houve a inibição da atividade *TNF-α in vivo.* Já em relação aos efeitos pró-osteogênico, foi relatado o aumento da atividade da fosfatase alcalina, expressão de *bone morphogenetic protein 2*, *runt-related transcription factor 2*, *osteocalcin* e *bone sialoprotein*, considerados marcadores osteogênicos.

Ahmed e colaboradores (2019) investigaram o papel de PhyCys no combate de alterações estruturais induzidas por metais pesados na glutationa redutase. Neste estudo foi testado a ação de PhyCys de mostarda amarela em glutationa redutases com mudanças conformacionais induzidas por metais pesados. Os resultados demonstraram que as PhyCys agem de forma competitiva com a glutationa redutase diminuindo a concentração destes metais pesados disponíveis para interagir com a glutationa redutase.

2.4 Ferramentas bioinformáticas importantes para análises evolutivas

Recentemente diversas espécies da linhagem vegetal tiveram seu genoma sequenciado, e suas informações estão disponíveis em bancos de dados públicos, como o projeto "*1000 plants*". E recentemente o projeto "*10000 plants",* previsto para ser concluído até 2022 (https://db.cngb.org/10kp/). A análise desta grande quantidade de dados só é possível com o

uso de ferramentas de bioinformática, como, por exemplo, as análises filogenéticas, que permitem a inferência sobre a evolução de proteínas e genes.

Uma das ferramentas mais importantes é o BLAST - *Basic Local Alignment Search Tool* (ALTSCHUL et al., 1990), que permite, a partir das sequências de nucleotídeos ou aminoácidos, identificar uma homologia de forma rápida, encontrar regiões conservadas, identificando sequências homólogas nas amostras analisadas. Esta ferramenta é dividida em variantes, como, blastn para nucleotídeos, blastp para proteínas, tblastn para aminoácidos traduzidos para nucleotídeos, blastx para nucleotídeos traduzidos para aminoácidos. Onde o objetivo final é alinhar localmente as sequências de interesse (*query*) com as que se deseja buscar homologia (*subject*) (MCGINNIS; MADDEN, 2004).

Após a obtenção das sequências homólogas nos organismos alvo, é importante e necessário fazer uma etapa de curagem, que consiste em confirmar se a sequência encontrada no caso de proteínas, apresente o domínio conservado, ou seja, a região funcional da proteína de interesse da busca (JANIN; WODAK, 1983; XU; NUSSINOV, 1998). Para isso, ferramentas como Blast2GO (CONESA et al., 2005), onde, pode ser realizado o BLAST contra o banco de dados nr/nt (engloba todas as sequências de aminoácidos e nucleotídeos presentes no NCBI - *National Center for Biotechnology Information* sem repetição), com as sequências de interesse e utilizar a ferramenta InterProScan (HUNTER et al., 2012), para encontrar o domínio conservado das sequências no banco de dados Pfam (FINN et al., 2007) ou outros.

A partir da curagem, as sequências selecionadas, junto as sequências usadas como *query* no primeiro BLAST, são alinhadas globalmente, com ferramentas como CLUSTAW (THOMPSON; HIGGINS; GIBSON, 1994) ou MUSCLE - *Multiple Sequence Comparison by Log-Expectation* (EDGAR, 2004). Os resultados gerados pelo alinhamento global permite inferir, no caso de proteínas, relações como, sequência conservada do sítio ativo ou motivos estruturais importantes conservados. A partir do alinhamento é possível construir uma árvore filogenética, utilizando ferramentas como MEGAX - *Molecular Evolutionary Genetics Analysis* (KUMAR et al., 2018), que nos possibilita inferir sobre a relação entre as sequências analisadas, como sua relação evolutiva e ajudar classificar proteínas dentro de uma família ou superfamília (SAITOU; NEI, 1987; TAUBENBERGER et al., 2005; VÉRAS et al., 2011).

3 OBJETIVOS

3.1 Objetivo geral

Realizar a identificação e análise evolutiva *in silico* de PhyCys em espécies de algas, algas verdes, briófitas e pteridófitas.

3.2 Objetivos específicos

- Construir bancos de dados com as sequências de algas, algas verdes, briófitas e pteridófitas presentes no banco de dados *1000 plants*;
- Identificar *in silico* PhyCys presentes nos genomas de algas, algas verdes, briófitas e pteridófitas;
- Confirmar a presença do domínio conservado de fitocistatina nos resultados obtidos;
- Realizar o alinhamento e a construção de uma árvore filogenética para classificar as sequências encontradas.

4 MATERIAL E MÉTODOS

4.1 Seleção de genes de fitocistatinas

As sequências de aminoácidos dos genes de PhyCys de *Arabidopsis thaliana* e *O. sativa,* foram obtidas a partir do banco de dados UniProt - *The Universal Protein Resource* (http://www.uniprot.org/) (TABELA 1). Estas sequências foram usadas como "*query*" nos experimentos seguintes.

4.2 Construção dos bancos de dados

Foram construídos bancos de dados para os proteomas de algas, algas verdes, briófitas e pteridófitas com a ferramenta BLAST+ (CAMACHO et al., 2009). Os proteomas foram

obtidos a partir do banco de dados *1000 Plants* (https://db.cngb.org/onekp/) (APÊNDICE 1, TABELA 2).

Tabela 1. Genes de PhyCys de *A. thaliana* e *O. sativa*.

Gene/proteína	Identificador no UniProt	
CYS1 (Cysteine proteinase inhibitor 1)	Q945Q1	*A. thaliana*
CYS2 (Cysteine proteinase inhibitor 2)	Q8L5T9	
CYS3 (Cysteine proteinase inhibitor 3)	Q41906	
CYS4 (Cysteine proteinase inhibitor 4)	Q84WT8	
CYS5 (Cysteine proteinase inhibitor 5)	Q41916	
CYS6 (Cysteine proteinase inhibitor 6)	Q8H0X6	
Os01g0803200 (Cysteine proteinase inhibitor 1)	P09229	*O. sativa*
Os05g0494200 (Cysteine proteinase inhibitor 2)	P20907	
Os05g0409300 (Cysteine proteinase inhibitor 3)	Q6I570	
Os01g0915200 (Cysteine proteinase inhibitor 4)	Q5N806	
Os01g0915401 (Cysteine proteinase inhibitor 5)	Q0JGM8	
Os03g0210200 (Cysteine proteinase inhibitor 6)	Q10Q46	

Tabela 2. Número de genomas de cada grupo utilizado para construção dos bancos de dados.

Grupo	N° de genomas	Clados de cada grupo
Algas	68	*Glaucophyta, Red Algae, Chromista, Dinophyceae* e *Euglenozoa*
Algas verdes	168	*Green Algae*
Briófitas	82	*Mosses*, *Hornworts* e *Liverworts*
Pteridófitas	98	*Lycophytes*, *Eusporangiate Monilophytes* e *Leptosporangiate Monilophytes*
Total		416

4.3 Identificação dos genes de fitocistatinas nos genomas de espécies vegetais

As sequências listadas na Tabela 1 foram submetidas ao blastp (ALTSCHUL et al., 1990), contra os bancos de dados criados no item 4.2, e as sequências de aminoácidos ortólogas obtidas foram submetidas as ferramentas blastp e InterProScan, disponíveis no programa Blast2GO Free (CONESA et al., 2005), a fim de avaliar a presença do domínio

conservado ("*Cystatin domain"* IPR000010). E as sequências apresentando o domínio foram selecionadas para as análises seguintes. Das sequências com domínio conservado foram excluídas as sequências iguais da mesma espécie para as análises subsequentes.

4.4 Alinhamento das sequências de aminoácidos

O alinhamento foi realizado utilizando a ferramenta MUSCLE, presente no programa MEGAX - *Molecular Evolutionary Genetics Analysis* (KUMAR et al., 2018), utilizando as sequências da Tabela 1 junto as sequências obtidas no item 4.3. Os resultados foram otimizados no programa BioEdit 7.2.6 (HALL, 1999).

4.5 Análise filogenética

A análise filogenética foi realizada a partir dos alinhamentos otimizados das sequências de aminoácidos obtidas no programa MEGAX, utilizando o método *Neighbor-joining* (SAITOU; NEI, 1987), com teste *bootstrap* (FELSENSTEIN JOSEPH, 1985) com valor de 1000 réplicas, e a distância evolutiva computada utilizando o método JTT (Jones-Taylor-Thornton) (JONES; TAYLOR; THORNTON, 1992).

5 RESULTADOS E DISCUSSÃO

5.1 Identificação das fitocistatinas

Nos resultados do blastp, não foram encontradas sequências homólogas a PhyCys nos grupos de algas mais primitivas. Porém, foram encontradas sequências homólogas a PhyCys em algas verdes, briófitas e pteridófitas (APÊNDICE 2A, 2B e 2C). Já na busca por domínios conservados, quase todas as sequências apresentaram o domínio de cistatina "*InterPro entry:* IPR000010". Foram excluídas 1 sequência de algas verdes, briófitas e pteridófita por não apresentarem este domínio.

A falta de resultados em algas, pode se relacionar com a distância evolutiva entre as plantas superiores e estas algas (YOON et al., 2004). Nestas algas mais primitivas podem

estar presentes outros tipos de inibidores de protease, já que essas proteínas são importantes para o funcionamento celular (HELLINGER; GRUBER, 2019, CANNELL et al., 1988).

Foram encontradas proteínas com similaridade a PhyCys em algas verdes, chlorophyta e streptophyta, apesar da sua distância evolutiva (APÊNDICE 2A). Notavelmente, devemos observar que as cistatinas estão presentes em genomas animais (NIT et al., 1997; WEI et al., 2019), indicando sua possível origem anterior a divergência entre plantas e animais. Nota-se que apesar de terem sido identificadas PhyCys em chlorophyta e streptophyta, a maioria das espécies são de streptophyta.

Adicionalmente foram encontradas PhyCys em todas as divisões de briófitas (APÊNDICE 2B) e nos grupos de pteridófitas (APÊNDICE 2C). Em briófitas foram encontrados mais genes de PhyCys principalmente em hepáticas e musgos (*liverworts* e *mosses*). Notavelmente foram encontradas na maioria das espécies de antóceros (*hornworts*), porém em menor quantidade de genes por espécie. Hepáticas e musgos são as linhagens mais próximas as plantas vasculares (RAVEN; EVERT; EICHHORN, 2013).

Foram identificados genes de PhyCys em 28 espécies de algas verdes (93% das streptophytas), em 66 espécies de briófitas e 39 espécies de pteridófitas. O número máximo de genes por espécie em algas verdes foi de 2 genes, em briófitas 6 genes em *Leucobryum albidum* e em pteridófitas 4 genes em *Polypodium amorphum* (TABELA 3). Nota-se portanto um aumento no número de genes por espécie em relação a algas verdes, provavelmente provocado por eventos de duplicação ao longo do tempo.

5.2 Alinhamento das sequências encontradas

Nos alinhamentos (APÊNDICE 3A, 3B e 3C), podemos visualizar os resíduos de glicina conservados na porção N-terminal, a região semelhante a LARFAVDEHN, os motivos conservados semelhantes a QxVxG e YEAKxKxWxKxF, similar ao descrito por outros autores em plantas mono e dicotiledôneas (CHAUHAN; JASRAI; PANDYA, 2015; MARGIS; REIS; VILLERET, 1998).

Tabela 3: Número de espécies em que foram identificados genes de PhyCys. Estão mostrados o número de genes por espécie e % de espécies em relação ao número de espécies presente no banco de dados criado para as análises.

Grupo	N° de espécies	N° de genes por espécie	% de espécies em relação a ao total de espécies do banco.
Algas verdes	28	1 gene: *Entransia fimbriat, Desmidium aptogonum, Chaetosphaeridium globosum, Onychonema laeve, Coccomyxa pringsheimii, Spirogyra* sp.*, Cosmarium ochthodes, Mesotaenium caldariorum, Staurastrum sebaldi, Micrasterias fimbriata, Zygnemopsis* sp.*, Cosmarium granatum, Mesotaenium kramstei, Coleochaete irregularis, Chloromonas perforata, Bambusina borreri, Phymatodocis nordstedtiana, Staurodesmus omearii, Zygnema* sp.*, Mesotaenium endlicherianum, Roya obtusa, Penium exiguum;* 2 genes: *Cylindrocystis cushleckae, Gonatozygon kinahanii, Cylindrocystis brebissonii* (M2853)*, Cylindrocystis brebissonii* (M2213)*, Cylindrocystis* sp.*, Spirotaenia* sp.*, Mesotaenium braunii.*	17% (93% streptophyta)
Briófitas	66	1 gene: *Diphyscium foliosum, Radula lindenbergia, Scouleria aquatica, Anthoceros agrestis, Nothoceros aenigmaticus, Sphaerocarpos texanus, Ptilidium pulcherrimum, Conocephalum conicum, Scapania nemorosa, Pellia neesiana, Marchantia polymorpha, Porella navicularis, Schistochila* sp., *Barbilophozia barbata, Philonotis fontana, Calypogeia fissa, Phaeoceros carolinianus, Takakia lepidozioides, Megaceros vincentianus, Marchantia emarginata, Anthoceros agrestis, Lunularia cruciata, Sphagnum recurvatum, Porella pinnata, Odontoschisma prostratum, Phaeoceros carolinianus, Atrichum angustatum;* 2 genes: *Niphotrichum elongatum, Plagiomnium insigne, Lejeuneaceae* sp.*, Treubia lacunose, Sphagnum lescurii, Encalypta streptocarpa, Pellia* cf.*, Polytrichum commune, Calliergon cordifolium, Frullania cysteine, Riccia berychiana. Hedwigia ciliata;* 3 genes: *Orthotrichum lyellii, Fontinalis antipyretica, Thuidium delicatulum, Marchantia paleacea, Schwetschkeopsis fabronia, Rhynchostegium serrulatum, Bryum argenteum, Hypnum subimponens, Dicranum scoparium, Pseudotaxiphyllum elegans, Anomodon attenuatus, Sphagnum palustre, Leucobryum glaucum, Monoclea gottschei, Neckera douglasii, Anomodon rostratus, Aulacomnium heterostichum, Rhytidiadelphus loreus, Timmia austriaca;* 4 genes: *Ceratodon purpureus, Climacium dendroides,*	80%

		Funaria cysteine, Physcomicromitrium cf., *Leucodon sciuroides*; 5 genes: *Tetraphis pellucida, Racomitrium varium;* 6 genes: *Leucobryum albidum.*	
Pteridófitas	39	1 gene: *Botrypus virginianus, Huperzia myrisinites, Danaea nodosa, Sceptridium dissectum, Huperzia squarrosa, Huperzia lucidula, Selaginella willdenowii, Selaginella apoda, Huperzia selago, Isoetes tegetiformans, Ophioglossum vulgatum, Psilotum nudum, Marattia attenuata, Lonchitis hirsuta, Diphasiastrum digitatum, Ophioglossum vulgatum, Argyrochosma nivea, Selaginella kraussiana;* 2 genes: *Tmesipteris parva, Lycopodium annotinum, Huperzia selago, Nephrolepis exaltata, Isoetes* sp.*, Lycopodiella apressa, Pseudolycopodiella caroliniana, Marattia* sp.*, Adiantum aleuticum, Leucostegia immersa, Dendrolycopodium obscurum, Notholaena montieliae, Woodsia scopulina, Hemionitis arifolia;* 3 genes: *Equisetum diffusum, Equisetum hymale, Cryptogramma acrostichoides, Lindsaea microphylla, Woodsia ilvensis, Polypodium plectolens;* 4 genes: *Polypodium amorphum..*	40%

A Tabela 4 apresenta as regiões específicas de cada alinhamento. Pode se observar os aminoácidos conservados GG na porção N-terminal e F na porção C-terminal. E os motivos semelhantes a LAxFAV-HN, QVVxG e YEAKVWxPWE. Após todos os tratamentos, foram obtidas 36 PhyCys putativas em algas verdes, 144 em briófitas e 68 em pteridófitas. O número de genomas utilizados para cada grupo está presente na Tabela 2.

Tabela 4. Sequências específicas de aminoácidos obtidas a partir dos alinhamentos das sequências de PhyCys putativas encontradas em algas verdes, briófitas e pteridófitas.

Algas verdes	Briófitas	Pteridófitas
GG-V-G	GGxKxV	GG
ND-ELAxFAVxEHNxK	NSLEIDELAxFAVxEHN	NSxE-DLAKFAVxQHN
N	N-S	QNS
LxF-VVSA-QVVAGT-YxLTxEA	LxFSKVVSAxQVVxGTMYHLTIEV	LxYxRxVSA-QVVAGxMYHL-EA
G-YEAKVWxKPWENFKxL-F	E-PKxYEAKVWVKPWE-KxLExF	S-G-YEAKVWxKPWExFKSLExF

5.3 Análise filogenética

As árvores filogenéticas construídas podem ser visualizadas na Figura 3, 4 e 5. Observa-se que não houve formação de clados específicos que possibilitaram a classificação das PhyCys com os grupos classificados com as sequências de plantas mono e dicotiledôneas. Estes resultados podem indicar que a classificação das PhyCys por homologia não se aplica a algas verdes, briófitas e pteridófitas, sendo necessária uma nova classificação para estas proteínas. Em todas as 3 árvores, as sequências *query* ficaram agrupadas e os organismos mais próximos taxonomicamente também ficaram agrupados.

Na Figura 3 temos a árvore filogenética com as PhyCys encontradas em algas verdes junto com as sequências de referência de *Arabdopsis thaliana* e *O. sativa* (marcadas em vermelho). Nessa filogenia vemos que apenas duas PhyCys de algas se agruparam junto das sequências de referência, uma da espécie *Entransia fimbriata*, que é uma streptophyta, e outra da espécie *Chlorococcum microstigmaticum*, que é uma chlorophyta. Notavelmente, a maioria dos genes de PhyCys encontrados em algas foram identificados em espécies de streptophyta. Acredita-se que as plantas superiores tenham evoluído a partir de algas streptophyta, e a presença de genes de PhyCys principalmente nessas algas podem ajudar a confirmar essa hipótese (RAVEN; EVERT; EICHHORN, 2013).

Na Figura 4 e 5 estão presentes as árvores de briófitas e pteridófitas, nota-se que poucas sequências de briófitas se agrupam com as PhyCys de referência, similarmente a árvore filogenética de algas verdes, e na árvore de pteridófitas não houve nenhuma sequência agrupada com as de referência. As espécies de briófitas que se agruparam foram *Monoclea gottschei* (hepática), *Treubia lacunose* (hepática) e *Sphagnum lescurii* (musgo).

Figura 3. Árvore filogenética gerada a partir das PhyCys encontradas em algas verdes.

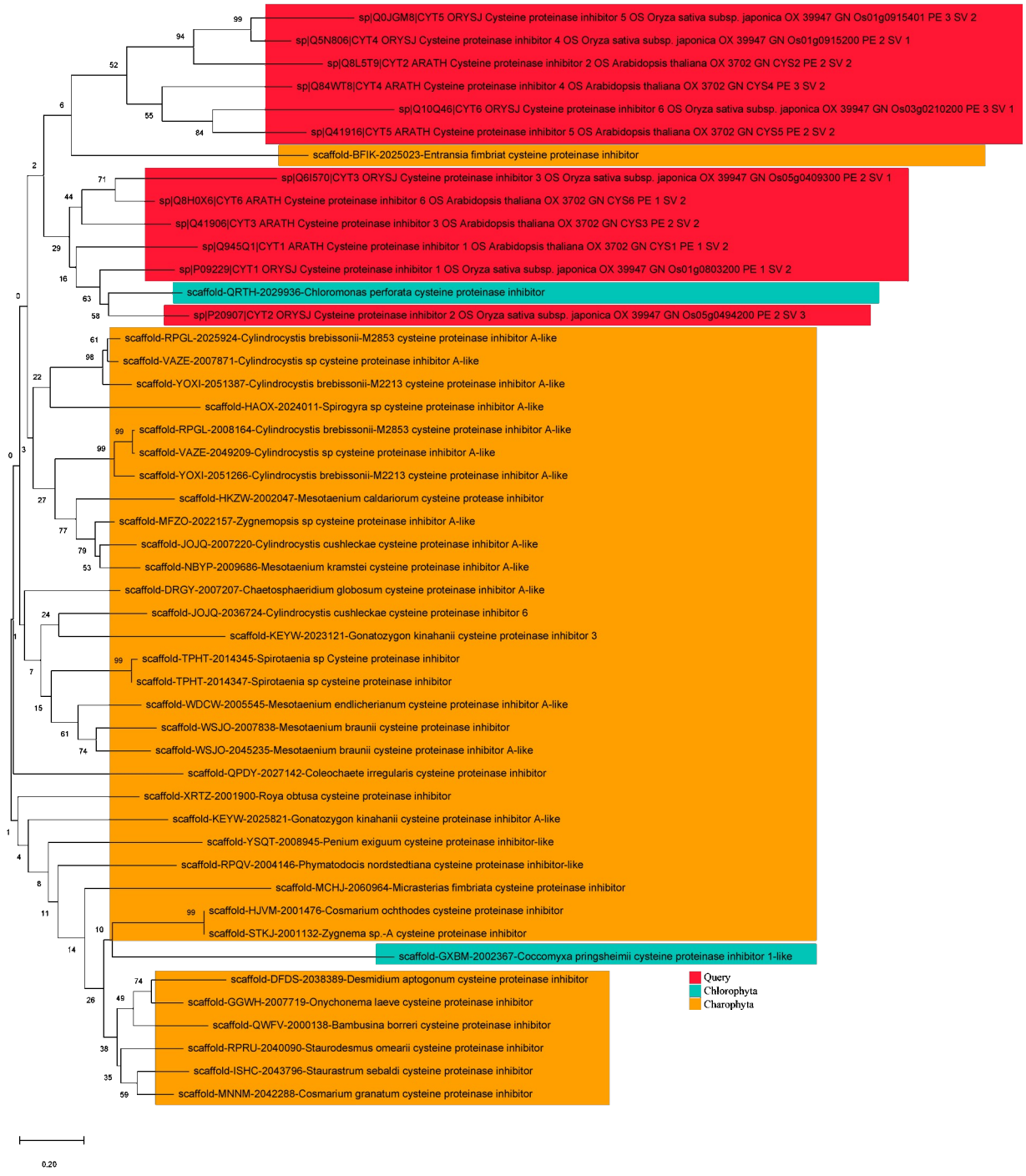
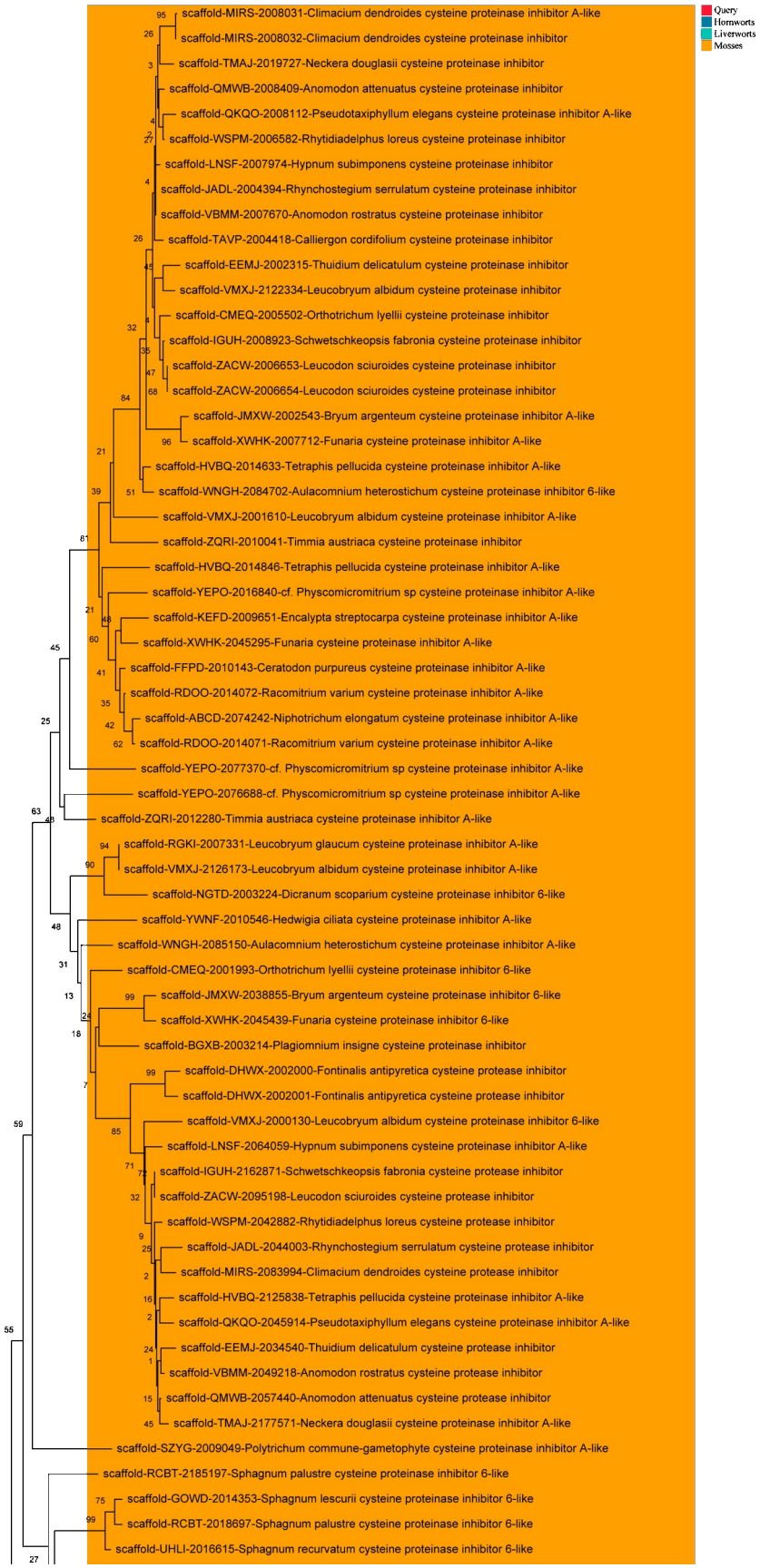
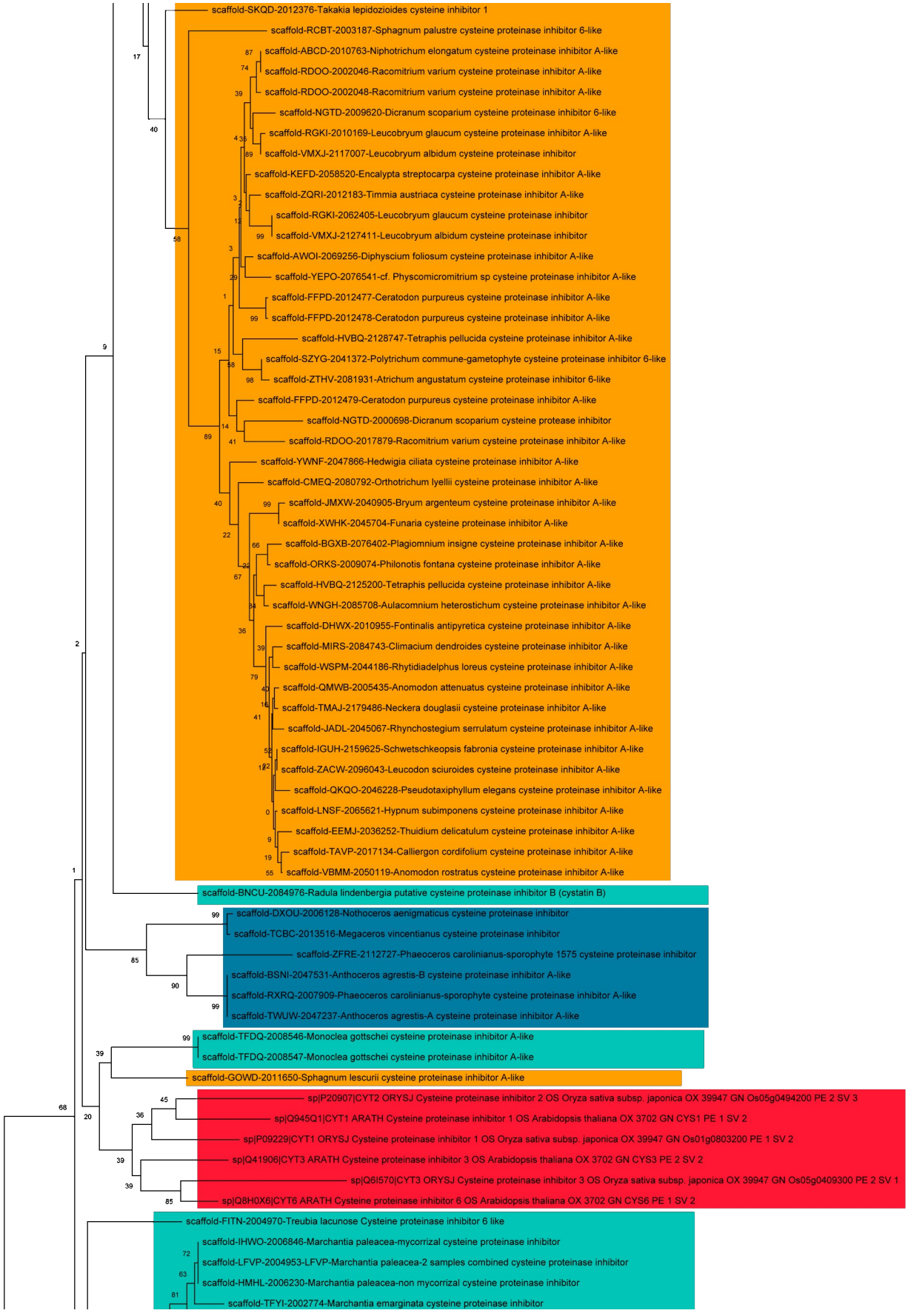


Figura 4. Árvore filogenética das PhyCys putativas encontradas em briófitas.




scaffold-SKQD-2012376-Takakia lepidozioides cysteine inhibitor 1
scaffold-RCBT-2003187-Sphagnum palustre cysteine proteinase inhibitor 6-like
scaffold-ABCD-2010763-Niphotrichum elongatum cysteine proteinase inhibitor A-like
scaffold-RDOO-2002046-Racomitrium varium cysteine proteinase inhibitor A-like
scaffold-RDOO-2002048-Racomitrium varium cysteine proteinase inhibitor A-like
scaffold-NGTD-2009620-Dicranum scoparium cysteine proteinase inhibitor 6-like
scaffold-RGKI-2010169-Leucobryum glaucum cysteine proteinase inhibitor A-like
scaffold-VMXJ-2117007-Leucobryum albidum cysteine proteinase inhibitor
scaffold-KEFD-2058520-Encalypta streptocarpa cysteine proteinase inhibitor A-like
scaffold-ZQRI-2012183-Timmia austriaca cysteine proteinase inhibitor A-like
scaffold-RGKI-2062405-Leucobryum glaucum cysteine proteinase inhibitor
scaffold-VMXJ-2127411-Leucobryum albidum cysteine proteinase inhibitor
scaffold-AWOI-2069256-Diphyscium foliosum cysteine proteinase inhibitor A-like
scaffold-YEPO-2076541-cf. Physcomicromitrium sp cysteine proteinase inhibitor A-like
scaffold-FFPD-2012477-Ceratodon purpureus cysteine proteinase inhibitor A-like
scaffold-FFPD-2012478-Ceratodon purpureus cysteine proteinase inhibitor A-like
scaffold-HVBQ-2128747-Tetraphis pellucida cysteine proteinase inhibitor A-like
scaffold-SZYG-2041372-Polytrichum commune-gametophyte cysteine proteinase inhibitor 6-like
scaffold-ZTHV-2081931-Atrichum angustatum cysteine proteinase inhibitor 6-like
scaffold-FFPD-2012479-Ceratodon purpureus cysteine proteinase inhibitor A-like
scaffold-NGTD-2000698-Dicranum scoparium cysteine protease inhibitor
scaffold-RDOO-2017879-Racomitrium varium cysteine proteinase inhibitor A-like
scaffold-YWNF-2047866-Hedwigia ciliata cysteine proteinase inhibitor A-like
scaffold-CMEQ-2080792-Orthotrichum lyellii cysteine proteinase inhibitor A-like
scaffold-JMXW-2040905-Bryum argenteum cysteine proteinase inhibitor A-like
scaffold-XWHK-2045704-Funaria cysteine proteinase inhibitor A-like
scaffold-BGXB-2076402-Plagiomnium insigne cysteine proteinase inhibitor A-like
scaffold-ORKS-2009074-Philonotis fontana cysteine proteinase inhibitor A-like
scaffold-HVBQ-2125200-Tetraphis pellucida cysteine proteinase inhibitor A-like
scaffold-WNGH-2085708-Aulacomnium heterostichum cysteine proteinase inhibitor A-like
scaffold-DHWX-2010955-Fontinalis antipyretica cysteine proteinase inhibitor A-like
scaffold-MIRS-2084743-Climacium dendroides cysteine proteinase inhibitor A-like
scaffold-WSPM-2044186-Rhytidiadelphus loreus cysteine proteinase inhibitor A-like
scaffold-QMWB-2005435-Anomodon attenuatus cysteine proteinase inhibitor A-like
scaffold-TMAJ-2179486-Neckera douglasii cysteine proteinase inhibitor A-like
scaffold-JADL-2045067-Rhynchostegium serrulatum cysteine proteinase inhibitor A-like
scaffold-IGUH-2159625-Schwetschkeopsis fabronia cysteine proteinase inhibitor A-like
scaffold-ZACW-2096043-Leucodon sciuroides cysteine proteinase inhibitor A-like
scaffold-QKQO-2046228-Pseudotaxiphyllum elegans cysteine proteinase inhibitor A-like
scaffold-LNSF-2065621-Hypnum subimponens cysteine proteinase inhibitor A-like
scaffold-EEMJ-2036252-Thuidium delicatulum cysteine proteinase inhibitor A-like
scaffold-TAVP-2017134-Calliergon cordifolium cysteine proteinase inhibitor A-like
scaffold-VBMM-2050119-Anomodon rostratus cysteine proteinase inhibitor A-like
scaffold-BNCU-2084976-Radula lindenbergia putative cysteine proteinase inhibitor B (cystatin B)
scaffold-DXOU-2006128-Nothoceros aenigmaticus cysteine proteinase inhibitor
scaffold-TCBC-2013516-Megaceros vincentianus cysteine proteinase inhibitor
scaffold-ZFRE-2112727-Phaeoceros carolinianus-sporophyte 1575 cysteine proteinase inhibitor
scaffold-BSNI-2047531-Anthoceros agrestis-B cysteine proteinase inhibitor A-like
scaffold-RXRQ-2007909-Phaeoceros carolinianus-sporophyte cysteine proteinase inhibitor A-like
scaffold-TWUW-2047237-Anthoceros agrestis-A cysteine proteinase inhibitor A-like
scaffold-TFDQ-2008546-Monoclea gottschei cysteine proteinase inhibitor A-like
scaffold-TFDQ-2008547-Monoclea gottschei cysteine proteinase inhibitor A-like
scaffold-GOWD-2011650-Sphagnum lescurii cysteine proteinase inhibitor A-like
sp|P20907|CYT2 ORYSJ Cysteine proteinase inhibitor 2 OS Oryza sativa subsp. japonica OX 39947 GN Os05g0494200 PE 2 SV 3
sp|Q945Q1|CYT1 ARATH Cysteine proteinase inhibitor 1 OS Arabidopsis thaliana OX 3702 GN CYS1 PE 1 SV 2
sp|P09229|CYT1 ORYSJ Cysteine proteinase inhibitor 1 OS Oryza sativa subsp. japonica OX 39947 GN Os01g0803200 PE 1 SV 2
sp|Q41906|CYT3 ARATH Cysteine proteinase inhibitor 3 OS Arabidopsis thaliana OX 3702 GN CYS3 PE 2 SV 2
sp|Q6I570|CYT3 ORYSJ Cysteine proteinase inhibitor 3 OS Oryza sativa subsp. japonica OX 39947 GN Os05g0409300 PE 2 SV 1
sp|Q8H0X6|CYT6 ARATH Cysteine proteinase inhibitor 6 OS Arabidopsis thaliana OX 3702 GN CYS6 PE 1 SV 2
scaffold-FITN-2004970-Treubia lacunose Cysteine proteinase inhibitor 6 like
scaffold-IHWO-2006846-Marchantia paleacea-mycorrizal cysteine proteinase inhibitor
scaffold-LFVP-2004953-LFVP-Marchantia paleacea-2 samples combined cysteine proteinase inhibitor
scaffold-HMHL-2006230-Marchantia paleacea-non mycorrizal cysteine proteinase inhibitor
scaffold-TFYI-2002774-Marchantia emarginata cysteine proteinase inhibitor

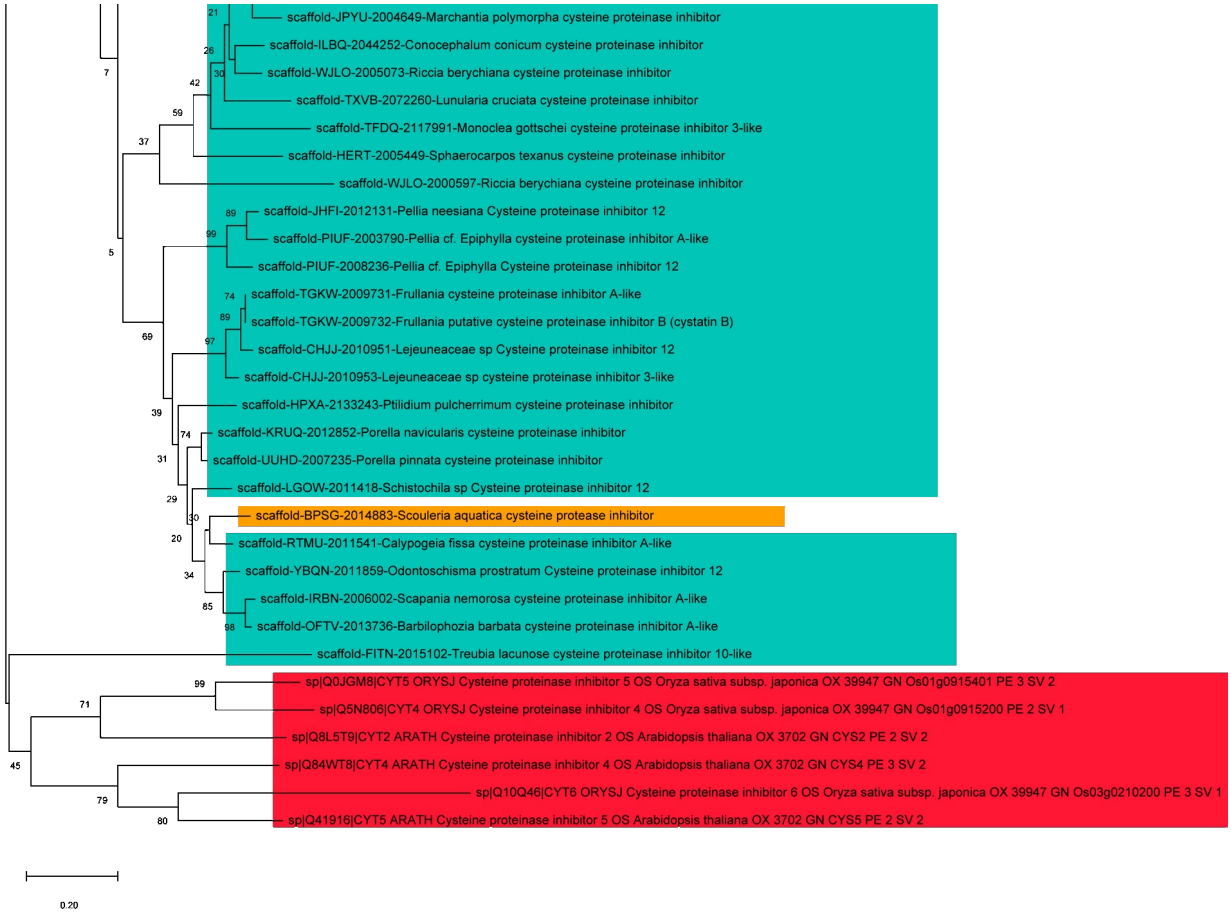
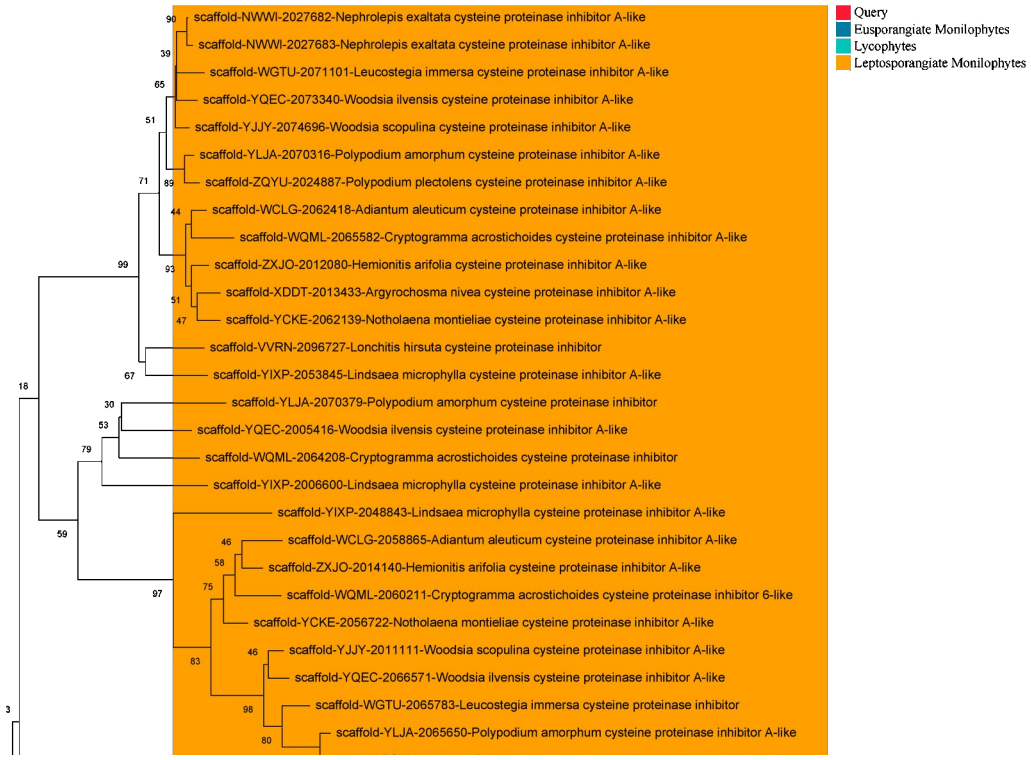
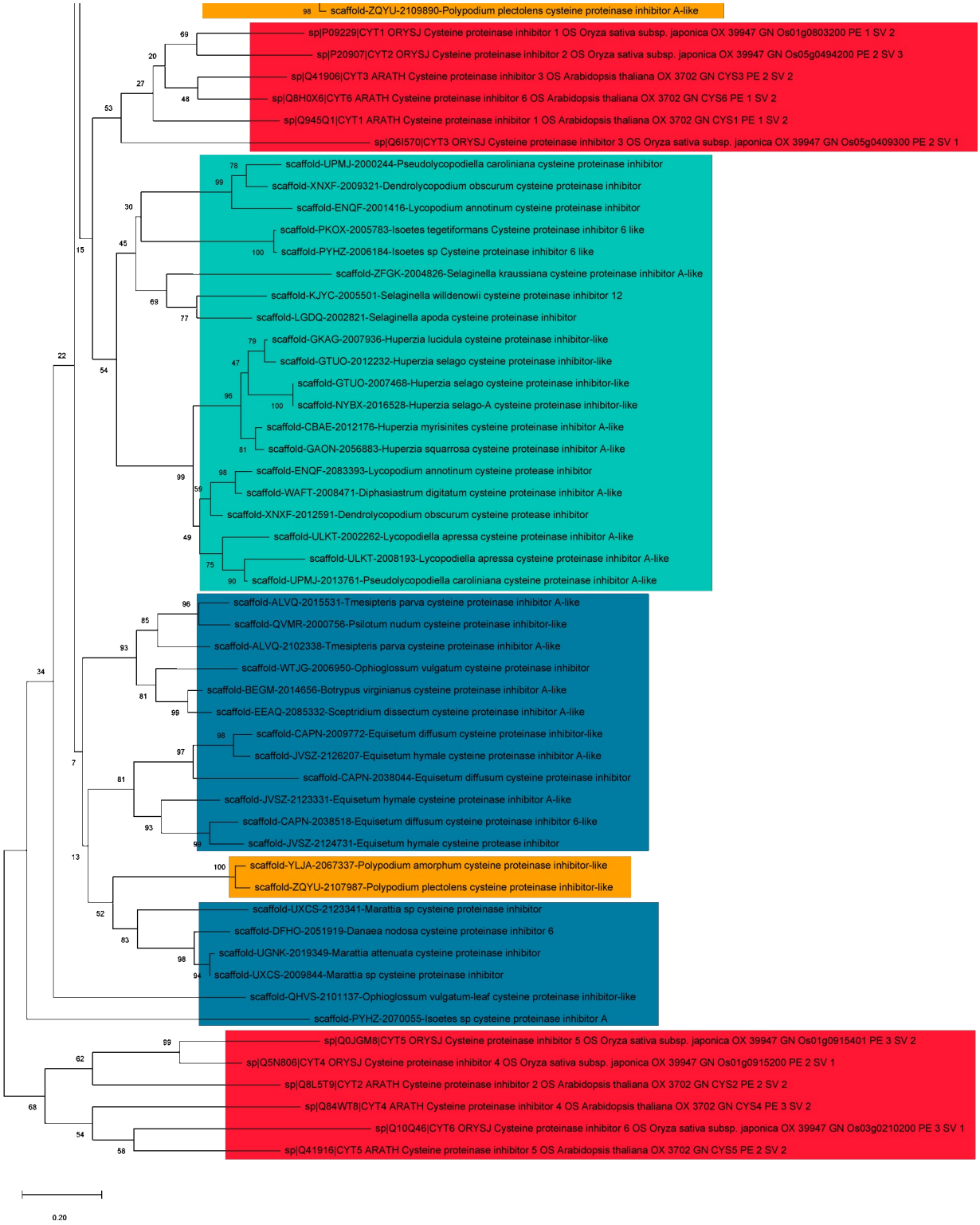


Figura 5. Árvore filogenética das PhyCys putativas encontradas em pteridófitas.




scaffold-ZQYU-2109890-Polypodium plectolens cysteine proteinase inhibitor A-like
sp|P09229|CYT1 ORYSJ Cysteine proteinase inhibitor 1 OS Oryza sativa subsp. japonica OX 39947 GN Os01g0803200 PE 1 SV 2
sp|P20907|CYT2 ORYSJ Cysteine proteinase inhibitor 2 OS Oryza sativa subsp. japonica OX 39947 GN Os05g0494200 PE 2 SV 3
sp|Q41906|CYT3 ARATH Cysteine proteinase inhibitor 3 OS Arabidopsis thaliana OX 3702 GN CYS3 PE 2 SV 2
sp|Q8H0X6|CYT6 ARATH Cysteine proteinase inhibitor 6 OS Arabidopsis thaliana OX 3702 GN CYS6 PE 1 SV 2
sp|Q945Q1|CYT1 ARATH Cysteine proteinase inhibitor 1 OS Arabidopsis thaliana OX 3702 GN CYS1 PE 1 SV 2
sp|Q6I570|CYT3 ORYSJ Cysteine proteinase inhibitor 3 OS Oryza sativa subsp. japonica OX 39947 GN Os05g0409300 PE 2 SV 1
scaffold-UPMJ-2000244-Pseudolycopodiella caroliniana cysteine proteinase inhibitor
scaffold-XNXF-2009321-Dendrolycopodium obscurum cysteine proteinase inhibitor
scaffold-ENQF-2001416-Lycopodium annotinum cysteine proteinase inhibitor
scaffold-PKOX-2005783-Isoetes tegetiformans Cysteine proteinase inhibitor 6 like
scaffold-PYHZ-2006184-Isoetes sp Cysteine proteinase inhibitor 6 like
scaffold-ZFGK-2004826-Selaginella kraussiana cysteine proteinase inhibitor A-like
scaffold-KJYC-2005501-Selaginella willdenowii cysteine proteinase inhibitor 12
scaffold-LGDQ-2002821-Selaginella apoda cysteine proteinase inhibitor
scaffold-GKAG-2007936-Huperzia lucidula cysteine proteinase inhibitor-like
scaffold-GTUO-2012232-Huperzia selago cysteine proteinase inhibitor-like
scaffold-GTUO-2007468-Huperzia selago cysteine proteinase inhibitor-like
scaffold-NYBX-2016528-Huperzia selago-A cysteine proteinase inhibitor-like
scaffold-CBAE-2012176-Huperzia myrisinites cysteine proteinase inhibitor A-like
scaffold-GAON-2056883-Huperzia squarrosa cysteine proteinase inhibitor A-like
scaffold-ENQF-2083393-Lycopodium annotinum cysteine protease inhibitor
scaffold-WAFT-2008471-Diphasiastrum digitatum cysteine proteinase inhibitor A-like
scaffold-XNXF-2012591-Dendrolycopodium obscurum cysteine protease inhibitor
scaffold-ULKT-2002262-Lycopodiella apressa cysteine proteinase inhibitor A-like
scaffold-ULKT-2008193-Lycopodiella apressa cysteine proteinase inhibitor A-like
scaffold-UPMJ-2013761-Pseudolycopodiella caroliniana cysteine proteinase inhibitor A-like
scaffold-ALVQ-2015531-Tmesipteris parva cysteine proteinase inhibitor A-like
scaffold-QVMR-2000756-Psilotum nudum cysteine proteinase inhibitor-like
scaffold-ALVQ-2102338-Tmesipteris parva cysteine proteinase inhibitor A-like
scaffold-WTJG-2006950-Ophioglossum vulgatum cysteine proteinase inhibitor
scaffold-BEGM-2014656-Botrypus virginianus cysteine proteinase inhibitor A-like
scaffold-EEAQ-2085332-Sceptridium dissectum cysteine proteinase inhibitor A-like
scaffold-CAPN-2009772-Equisetum diffusum cysteine proteinase inhibitor-like
scaffold-JVSZ-2126207-Equisetum hymale cysteine proteinase inhibitor A-like
scaffold-CAPN-2038044-Equisetum diffusum cysteine proteinase inhibitor
scaffold-JVSZ-2123331-Equisetum hymale cysteine proteinase inhibitor A-like
scaffold-CAPN-2038518-Equisetum diffusum cysteine proteinase inhibitor 6-like
scaffold-JVSZ-2124731-Equisetum hymale cysteine protease inhibitor
scaffold-YLJA-2067337-Polypodium amorphum cysteine proteinase inhibitor-like
scaffold-ZQYU-2107987-Polypodium plectolens cysteine proteinase inhibitor-like
scaffold-UXCS-2123341-Marattia sp cysteine proteinase inhibitor
scaffold-DFHO-2051919-Danaea nodosa cysteine proteinase inhibitor 6
scaffold-UGNK-2019349-Marattia attenuata cysteine proteinase inhibitor
scaffold-UXCS-2009844-Marattia sp cysteine proteinase inhibitor
scaffold-QHVS-2101137-Ophioglossum vulgatum-leaf cysteine proteinase inhibitor-like
scaffold-PYHZ-2070055-Isoetes sp cysteine proteinase inhibitor A
sp|Q0JGM8|CYT5 ORYSJ Cysteine proteinase inhibitor 5 OS Oryza sativa subsp. japonica OX 39947 GN Os01g0915401 PE 3 SV 2
sp|Q5N806|CYT4 ORYSJ Cysteine proteinase inhibitor 4 OS Oryza sativa subsp. japonica OX 39947 GN Os01g0915200 PE 2 SV 1
sp|Q8L5T9|CYT2 ARATH Cysteine proteinase inhibitor 2 OS Arabidopsis thaliana OX 3702 GN CYS2 PE 2 SV 2
sp|Q84WT8|CYT4 ARATH Cysteine proteinase inhibitor 4 OS Arabidopsis thaliana OX 3702 GN CYS4 PE 3 SV 2
sp|Q10Q46|CYT6 ORYSJ Cysteine proteinase inhibitor 6 OS Oryza sativa subsp. japonica OX 39947 GN Os03g0210200 PE 3 SV 1
sp|Q41916|CYT5 ARATH Cysteine proteinase inhibitor 5 OS Arabidopsis thaliana OX 3702 GN CYS5 PE 2 SV 2
0.20

6 CONCLUSÃO

Foram identificadas *in silico* 36 PhyCys em 28 espécies de algas verdes, sendo a maioria streptophytas, 144 PhyCys em 66 espécies de briófitas e 68 PhyCys em 39 espécies pteridófitas, todas com a presença do domínio conservado de cistatina. A quantidade de genes por espécie aumentou de algas verdes para briófitas e pteridófitas. Os três grupos apresentaram motivos com aminoácidos conversados semelhantes GG, LAxFAV-HN, QVVxG e YEAKVWxPWE e F.

Não foi possível classificar as PhyCys a partir das árvores filogenéticas construídas, indicando um possível problema na classificação destas PhyCys por homologia. Uma alternativa seria utilizar mais sequências de PhyCys de outras espécies e famílias de cistatinas, ou mesmo propor uma nova classificação para estas proteínas, devido a maior distância genética das PhyCys dos vegetais analisados em comparação com as angiospermas. Estudos posteriores devem ser feitos para confirmar e caracterizar estas proteínas, além de entender quais são seus mecanismos e papel biológico em algas verdes, briófitas e pteridófitas. Estes estudos mais aprofundados podem contribuir para a compreensão de possíveis aplicações para estas PhyCys e a importância delas para a evolução dos vegetais.

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APÊNDICES

Apêndice 1: Espécies vegetais obtidas a partir do banco de dados *1000 Plants*.

1kP_Sample	*Clade*	*Family*	*Species*
GAON	Lycophytes	Lycopodiaceae	*Huperzia squarrosa*
GKAG	Lycophytes	Lycopodiaceae	*Huperzia lucidula*
NYBX	Lycophytes	Lycopodiaceae	*Huperzia selago*
CBAE	Lycophytes	Huperziaceae	*Huperzia myrsinites*
GTUO	Lycophytes	Huperziaceae	*Huperzia selago*
ULKT	Lycophytes	Lycopodiaceae	*Lycopodiella appressa*
PQTO	Lycophytes	Lycopodiaceae	*Lycopodium deuterodensum*
ENQF	Lycophytes	Lycopodiaceae	*Lycopodium annotinum*
UPMJ	Lycophytes	Lycopodiaceae	*Pseudolycopodiella caroliniana*
XNXF	Lycophytes	Lycopodiaceae	*Dendrolycopodium obscurum*
WAFT	Lycophytes	Lycopodiaceae	*Diphasiastrum digitatum*
PKOX	Lycophytes	Isoetaceae	*Isoetes tegetiformans*
PYHZ	Lycophytes	Isoetaceae	*Isoetes sp.*
LGDQ	Lycophytes	Selaginellaceae	*Selaginella apoda*
JKAA	Lycophytes	Selaginellaceae	*Selaginella wallacei*
ABIJ	Lycophytes	Selaginellaceae	*Selaginella lepidophylla*
ZZOL	Lycophytes	Selaginellaceae	*Selaginella stauntoniana*
KUXM	Lycophytes	Selaginellaceae	*Selaginella selaginoides*
ZFGK	Lycophytes	Selaginellaceae	*Selaginella kraussiana*
KJYC	Lycophytes	Selaginellaceae	*Selaginella willdenowii*
CAPN	Eusporangiate Monilophytes	Equisetaceae	*Equisetum diffusum*
JVSZ	Eusporangiate Monilophytes	Equisetaceae	*Equisetum hyemale*
UXCS	Eusporangiate Monilophytes	Marattiaceae	*Marattia sp.*
UGNK	Eusporangiate Monilophytes	Marattiaceae	*Marattia attenuata*
DFHO	Eusporangiate Monilophytes	Marattiaceae	*Danaea nodosa*
BEGM	Eusporangiate Monilophytes	Ophioglossaceae	*Botrypus virginianus*
WTJG	Eusporangiate Monilophytes	Ophioglossaceae	*Ophioglossum petiolatum*
QHVS	Eusporangiate Monilophytes	Ophioglossaceae	*Ophioglossum vulgatum*
EEAQ	Eusporangiate Monilophytes	Ophioglossaceae	*Sceptridium dissectum*
QVMR	Eusporangiate Monilophytes	Psilotaceae	*Psilotum nudum*
ALVQ	Eusporangiate Monilophytes	Psilotaceae	*Tmesipteris parva*
PNZO	Leptosporangiate Monilophytes	Culcitaceae	*Culcita macrocarpa*
GANB	Leptosporangiate Monilophytes	Cyatheaceae	*Cyathea (Alsophila) spinulosa*
EWXK	Leptosporangiate Monilophytes	Thyrsopteridaceae	*Thyrsopteris elegans*
XDVM	Leptosporangiate Monilophytes	Gleicheniaceae	*Sticherus lobatus*
MEKP	Leptosporangiate Monilophytes	Dipteridaceae	*Dipteris conjugata*
TWFZ	Leptosporangiate Monilophytes	Hymenophyllaceae	*Crepidomanes venosum*
QIAD	Leptosporangiate Monilophytes	Hymenophyllaceae	*Hymenophyllum bivalve*
TRPJ	Leptosporangiate Monilophytes	Hymenophyllaceae	*Hymenophyllum cupressiforme*
BIVQ	Leptosporangiate Monilophytes	Osmundaceae	*Osmundastrum cinnamomeum*
RFMZ	Leptosporangiate Monilophytes	Osmundaceae	*Osmundastrum cinnamomeum*
YKSS	Leptosporangiate Monilophytes	Osmundaceae	*Osmunda regalis*
UOMY	Leptosporangiate Monilophytes	Osmundaceae	*Osmunda sp.*
VIBO	Leptosporangiate Monilophytes	Osmundaceae	*Osmunda javanica*
UWOD	Leptosporangiate Monilophytes	Plagiogyriaceae	*Plagiogyria japonica*
IXLH	Leptosporangiate Monilophytes	Polypodiaceae	*Polypodium hesperium*
GYFU	Leptosporangiate Monilophytes	Polypodiaceae	*Polypodium hesperium*
YLJA	Leptosporangiate Monilophytes	Polypodiaceae	*Polypodium amorphum*

CJNT	Leptosporangiate Monilophytes	Polypodiaceae	*Polypodium glycyrrhiza*
ZQYU	Leptosporangiate Monilophytes	Polypodiaceae	*Phlebodium pseudoaureum*
UJWU	Leptosporangiate Monilophytes	Polypodiaceae	*Pleopeltis polypodioides*
ORJE	Leptosporangiate Monilophytes	Polypodiaceae	*Phymatosorus grossus*
OQWW	Leptosporangiate Monilophytes	Davalliaceae	*Davallia fejeensis*
NWWI	Leptosporangiate Monilophytes	Lomariopsidaceae	*Nephrolepis exaltata*
JBLI	Leptosporangiate Monilophytes	Elaphoglossaceae	*Bolbitis repanda*
FQGQ	Leptosporangiate Monilophytes	Dryopteridaceae	*Polystichum acrostichoides*
RFRB	Leptosporangiate Monilophytes	Hypodematiaceae	*Didymochlaena truncatula*
WGTU	Leptosporangiate Monilophytes	Hypodematiaceae	*Leucostegia immersa*
PSKY	Leptosporangiate Monilophytes	Aspleniaceae	*Asplenium nidus*
KJZG	Leptosporangiate Monilophytes	Aspleniaceae	*Asplenium platyneuron*
OCZL	Leptosporangiate Monilophytes	Diplaziopsidaceae	*Homalosorus pycnocarpos*
MROH	Leptosporangiate Monilophytes	Thelypteridaceae	*Thelypteris acuminata*
YJJY	Leptosporangiate Monilophytes	Woodsiaceae	*Woodsia scopulina*
YQEC	Leptosporangiate Monilophytes	Woodsiaceae	*Woodsia ilvensis*
HTFH	Leptosporangiate Monilophytes	Onocleaceae	*Onoclea sensibilis*
VITX	Leptosporangiate Monilophytes	Blechnaceae	*Blechnum spicant*
URCP	Leptosporangiate Monilophytes	Athyriaceae	*Athyrium filix-femina*
FCHS	Leptosporangiate Monilophytes	Athyriaceae	*Deparia lobato-crenata*
UFJN	Leptosporangiate Monilophytes	Athyriaceae	*Diplazium wichurae*
HNDZ	Leptosporangiate Monilophytes	Cystopteridaceae	*Cystopteris utahensis*
LHLE	Leptosporangiate Monilophytes	Cystopteridaceae	*Cystopteris fragilis*
XXHP	Leptosporangiate Monilophytes	Cystopteridaceae	*Cystopteris fragilis*
RICC	Leptosporangiate Monilophytes	Cystopteridaceae	*Cystopteris reevesiana*
YOWV	Leptosporangiate Monilophytes	Cystopteridaceae	*Cystopteris protrusa*
HEGQ	Leptosporangiate Monilophytes	Cystopteridaceae	*Gymnocarpium dryopteris*
MTGC	Leptosporangiate Monilophytes	Dennstaedtiaceae	*Dennstaedtia davallioides*
WCLG	Leptosporangiate Monilophytes	Pteridaceae	*Adiantum aleuticum*
BMJR	Leptosporangiate Monilophytes	Pteridaceae	*Adiantum raddianum*
DCDT	Leptosporangiate Monilophytes	Pteridaceae	*Gaga arizonica*
WQML	Leptosporangiate Monilophytes	Pteridaceae	*Cryptogramma acrostichoides*
ZXJO	Leptosporangiate Monilophytes	Pteridaceae	*Parahemionitis cordata*
POPJ	Leptosporangiate Monilophytes	Pteridaceae	*Pteris vittata*
FLTD	Leptosporangiate Monilophytes	Pteridaceae	*Pteris ensiformis*
UJTT	Leptosporangiate Monilophytes	Pteridaceae	*Pityrogramma trifoliata*
YCKE	Leptosporangiate Monilophytes	Pteridaceae	*Notholaena montieliae*
XDDT	Leptosporangiate Monilophytes	Pteridaceae	*Argyrochosma nivea*
GSXD	Leptosporangiate Monilophytes	Pteridaceae	*Myriopteris rufa*
SKYV	Leptosporangiate Monilophytes	Pteridaceae	*Vittaria lineata*
NDUV	Leptosporangiate Monilophytes	Pteridaceae	*Vittaria appalachiana*
PIVW	Leptosporangiate Monilophytes	Pteridaceae	*Ceratopteris thalictroides*
NOKI	Leptosporangiate Monilophytes	Lindsaeaceae	*Lindsaea linearis*
YIXP	Leptosporangiate Monilophytes	Lindsaeaceae	*Lindsaea microphylla*
BMIF	Leptosporangiate Monilophytes	Lindsaeaceae	*Aspenium sp.*
VVRN	Leptosporangiate Monilophytes	Lonchitidaceae	*Lonchitis hirsuta*
CVEG	Leptosporangiate Monilophytes	Salviniaceae	*Azolla cf. caroliniana*
KIIX	Leptosporangiate Monilophytes	Marsileaceae	*Pilularia globulifera*
CQPW	Leptosporangiate Monilophytes	Anemiaceae	*Anemia tomentosa*
PBUU	Leptosporangiate Monilophytes	Lygodiaceae	*Lygodium japonicum*
ORKS	Mosses	Bartramiaceae	*Philonotis fontana*
BGXB	Mosses	Mielichhoferiaceae	*Plagiomnium insigne*
JMXW	Mosses	Bryaceae	*Bryum argenteum*
WNGH	Mosses	Aulacomniaceae	*Aulacomnium heterostichum*

VBMM	Mosses	Brachytheciaceae	*Claopodium rostratum*
QMWB	Mosses	Myuriaceae	*Anomodon attenuatus*
ABCD	Mosses	Grimmiaceae	*Racomitrium elongatum*
RDOO	Mosses	Grimmiaceae	*Racomitrium varium*
BPSG	Mosses	Scouleriaceae	*Scouleria aquatica*
HRWG	Mosses	Buxbaumiaceae	*Buxbaumia aphylla*
NGTD	Mosses	Dicranaceae	*Dicranum scoparium*
VMXJ	Mosses	Leucobryaceae	*Leucobryum albidum*
RGKI	Mosses	Leucobryaceae	*Leucobryum glaucum*
FFPD	Mosses	Ditrichaceae	*Ceratodon purpureus*
AWOI	Mosses	Diphysciaceae	*Diphyscium foliosum*
KEFD	Mosses	Encalyptaceae	*Encalypta streptocarpa*
XWHK	Mosses	Bryaceae	*Rosulabryum cf. capillare*
YEPO	Mosses	Funariaceae	*Physcomitrium sp.*
YWNF	Mosses	Hedwigiaceae	*Hedwigia ciliata*
WSPM	Mosses	Hylocomiaceae	*Loeskeobryum brevirostre*
ZACW	Mosses	Leucodontaceae	*Leucodon brachypus*
LNSF	Mosses	Pylaisiaceae	*Stereodon subimponens*
QKQO	Mosses	Plagiotheciaceae	*Pseudotaxiphyllum elegans*
EEMJ	Mosses	Thuidiaceae	*Thuidium delicatulum*
JADL	Mosses	Brachytheciaceae	*Rhynchostegium serrulatum*
IGUH	Mosses	Leucodontaceae	*Leucodon julaceus*
TAVP	Mosses	Calliergonaceae	*Calliergon cordifolium*
MIRS	Mosses	Climaciaceae	*Climacium dendroides*
DHWX	Mosses	Fontinalaceae	*Fontinalis antipyretica*
TMAJ	Mosses	Neckeraceae	*Neckera douglasii*
CMEQ	Mosses	Orthotrichaceae	*Orthotrichum lyellii*
SZYG	Mosses	Polytrichaceae	*Polytrichum commune*
ZTHV	Mosses	Polytrichaceae	*Atrichum angustatum*
GRKU	Mosses	Pottiaceae	*Syntrichia princeps*
GOWD	Mosses	Sphagnaceae	*Sphagnum lescurii*
RCBT	Mosses	Sphagnaceae	*Sphagnum palustre*
UHLI	Mosses	Sphagnaceae	*Sphagnum recurvum*
SKQD	Mosses	Takakiaceae	*Takakia lepidozioides*
HVBQ	Mosses	Tetraphidaceae	*Tetraphis pellucida*
ZQRI	Mosses	Timmiaceae	*Timmia austriaca*
FANS	Hornworts	Leiosporocerotaceae	*Leiosporoceros dussii*
ANON	Hornworts	Leiosporocerotaceae	*Leiosporoceros dussii*
IQJU	Hornworts	Anthoceroceae	*Anthoceros angustus*
TWUW	Hornworts	Anthoceroceae	*Anthoceros agrestis*
BSNI	Hornworts	Anthoceroceae	*Anthoceros agrestis*
FAJB	Hornworts	Notothyladaceae	*Paraphymatoceros hallii*
WCZB	Hornworts	Notothyladaceae	*Phaeoceros carolinianus*
RXRQ	Hornworts	Notothyladaceae	*Phaeoceros carolinianus*
WEEQ	Hornworts	Notothyladaceae	*Phaeoceros carolinianus*
ZFRE	Hornworts	Notothyladaceae	*Phaeoceros carolinianus*
DXOU	Hornworts	Dendrocerotaceae	*Nothoceros aenigmaticus*
TCBC	Hornworts	Dendrocerotaceae	*Nothoceros vincentianus*
UCRN	Hornworts	Dendrocerotaceae	*Megaceros flagellaris*
AKXB	Hornworts	Dendrocerotaceae	*Phaeomegaceros coriaceus*
AEXY	Liverworts	Blasiaceae	*Blasia sp.*
YBQN	Liverworts	Cephaloziaceae	*Odontoschisma prostratum*
WZYK	Liverworts	Lepidoziaceae	*Bazzania trilobata*
RTMU	Liverworts	Calypogeiaceae	*Calypogeia fissa*

CHJJ	Liverworts	Frullaniaceae	*Frullania spp.*
IRBN	Liverworts	Scapaniaceae	*Scapania nemorosa*
OFTV	Liverworts	Scapaniaceae	*Barbilophozia barbata*
HPXA	Liverworts	Ptilidiaceae	*Ptilidium pulcherrimum*
LGOW	Liverworts	Schistochilaceae	*Schistochila sp.*
UUHD	Liverworts	Porellaceae	*Porella pinnata*
TGKW	Liverworts	Frullaniaceae	*Frullania sp.*
JPYU	Liverworts	Marchantiaceae	*Marchantia polymorpha*
TFYI	Liverworts	Marchantiaceae	*Marchantia emarginata*
HMHL	Liverworts	Marchantiaceae	*Marchantia paleacea*
IHWO	Liverworts	Marchantiaceae	*Marchantia paleacea*
ILBQ	Liverworts	Conocephalaceae	*Conocephalum conicum*
TXVB	Liverworts	Lunulariaceae	*Lunularia cruciata*
TFDQ	Liverworts	Monocleaceae	*Monoclea gottschei*
WJLO	Liverworts	Ricciaceae	*Ricciocarpos natans*
NRWZ	Liverworts	Metzgeriaceae	*Metzgeria crassipilis*
YFGP	Liverworts	Pallaviciniaceae	*Pallavicinia lyellii*
PIUF	Liverworts	Pelliaceae	*Pellia sp. (cf epiphylla (L.) Corda)*
JHFI	Liverworts	Pelliaceae	*Pellia neesiana*
YPSN	Liverworts	Pelliaceae	*Noteroclada confluens*
KRUQ	Liverworts	Porellaceae	*Porella navicularis*
BNCU	Liverworts	Radulaceae	*Radula lindenbergiana*
HERT	Liverworts	Sphaerocarpaceae	*Sphaerocarpos texanus*
FITN	Liverworts	Treubiaceae	*Treubia lacunosa*
XMCL	Green Algae	Prasinococcaceae	*Prasinococcus capsulatus*
XJGM	Green Algae	Prasinococcaceae	*coccoid-prasinophyte*
HYHN	Green Algae	Prasinococcaceae	*Prasinoderma coloniale*
MXEZ	Green Algae	Pycnococcaceae	*Pycnococcus provasolii*
JMTE	Green Algae	Pycnococcaceae	*Pseudoscourfieldia marina*
TNAW	Green Algae	Pyramimonadaceae	*Pyramimonas parkeae*
XIVI	Green Algae	Pyramimonadaceae	*Cymbomonas sp.*
MCPK	Green Algae	Mamiellaceae	*Bathycoccus prasinos*
QXSZ	Green Algae	Mamiellaceae	*Mantoniella squamata*
BTFM	Green Algae	Monomasticaceae	*Monomastix opisthostigma*
XOAL	Green Algae	Dolichomastigaceae	*Dolichomastix tenuilepis*
MMKU	Green Algae	Nephroselmidaceae	*Nephroselmis olivacea*
ISIM	Green Algae	Nephroselmidaceae	*Nephroselmis pyriformis*
FMVB	Green Algae	Chlorodendraceae	*Scherffelia dubia*
HVNO	Green Algae	Chlorodendraceae	*Tetraselmis chui*
DUMA	Green Algae	Chlorodendraceae	*Tetraselmis cordiformis*
HHXJ	Green Algae	Chlorodendraceae	*Tetraselmis striata*
BAZF	Green Algae	Chaetopeltidaceae	*Chaetopeltis orbicularis*
VFIV	Green Algae	Chaetophoraceae	*Fritschiella tuberosa*
AJAU	Green Algae	Chaetophoraceae	*Helicodictyon planctonicum*
NQYP	Green Algae	Chaetophoraceae	*Pirula salina*
JMUI	Green Algae	Chaetophoraceae	*Stigeoclonium helveticum*
RAWF	Green Algae	Chaetophoraceae	*Uronema belkae*
ISGT	Green Algae	Chaetophoraceae	*Uronema sp.*
IJMT	Green Algae	Aphanochaetaceae	*Aphanochaete repens*
GXBM	Green Algae	Coccomyxaceae	*Coccomyxa pringsheimii*
BZSH	Green Algae	Golenkiniaceae	*Golenkinia longispicula*
XKWQ	Green Algae	Hydrodictyaceae	*Pediastrum duplex CCAC 0012*
NLOM	Green Algae	Hydrodictyaceae	*Pediastrum duplex CCAC 0012*
XTON	Green Algae	Hydrodictyaceae	*Pediastrum duplex CCAC 0147*

PZIF	Green Algae	Scenedesmaceae	*Acutodesmus dimorphus*
ALZF	Green Algae	Chlorocystidaceae	*Halochlorococcum marinum*
USIX	Green Algae	Chlorosarcinaceae	*Neochlorosarcina sp.*
FOYQ	Green Algae	Microsporaceae	*Microspora cf. tumidula*
DVYE	Green Algae	Oedogoniaceae	*Oedogonium cardiacum*
SDPC	Green Algae	Oedogoniaceae	*Oedogonium foveolatum*
KUJU	Green Algae	Goniaceae	*Gonium pectorale*
EEJO	Green Algae	incertae sedis	*Neochloris oleoabundans*
KSFK	Green Algae	Chlorosarcinaceae	*Chlorosarcinopsis halophila*
GJIY	Green Algae	Neochloridaceae	*Neochloris sp.*
OTQG	Green Algae	Ankistrodesmaceae	*Ankistrodesmus sp.*
JWGT	Green Algae	Volvocaceae	*Volvox aureus*
WRSL	Green Algae	Volvocaceae	*Volvox aureus*
ISPU	Green Algae	Volvocaceae	*Volvox globator*
RNAT	Green Algae	Volvocaceae	*Eudorina elegans*
RYJX	Green Algae	Volvocaceae	*Pandorina morum*
MNPL	Green Algae	Asteromonadaceae	*Asteromonas gracilis*
NTLE	Green Algae	Asteromonadaceae	*Asteromonas gracilis*
VIAU	Green Algae	Carteriaceae	*Carteria crucifera*
RUIF	Green Algae	Carteriaceae	*Carteria obtusa*
MULF	Green Algae	Chlamydomonadaceae	*Chlamydomonas bilatus*
OVHR	Green Algae	Chlamydomonadaceae	*Chlamydomonas bilatus*
BCYF	Green Algae	Chlamydomonadaceae	*Chlamydomonas cribrum*
JRGZ	Green Algae	Chlamydomonadaceae	*Chlamydomonas moewusii*
VALZ	Green Algae	Chlamydomonadaceae	*Chlamydomonas noctigama*
TSBQ	Green Algae	Chlamydomonadaceae	*Chlamydomonas sp.*
GUBD	Green Algae	Chlamydomonadaceae	*Brachiomonas submarina*
IHOI	Green Algae	Chlamydomonadaceae	*Chloromonas oogama*
QRTH	Green Algae	Chlamydomonadaceae	*Chlorococcum microstigmaticum*
LBRP	Green Algae	Chlamydomonadaceae	*Chloromonas reticulata*
GDUD	Green Algae	Chlamydomonadaceae	*Chloromonas reticulata*
AJUW	Green Algae	Chlamydomonadaceae	*Chloromonas rosae v. psychrophila*
GFUR	Green Algae	Chlamydomonadaceae	*Chloromonas subdivisa*
UTRE	Green Algae	Chlamydomonadaceae	*Chloromonas tughillensis*
IRYH	Green Algae	Chlamydomonadaceae	*Heterochlamydomonas inaequalis*
OFUE	Green Algae	Chlamydomonadaceae	*Lobochlamys segnis*
JKKI	Green Algae	Chlamydomonadaceae	*Lobomonas rostrata*
XDLL	Green Algae	Chlamydomonadaceae	*Oogamochlamys gigantea*
MXDS	Green Algae	Chlamydomonadaceae	*Spermatozopsis exsultans*
ENAU	Green Algae	Chlamydomonadaceae	*Spermatozopsis similis*
QWRA	Green Algae	Chlamydomonadaceae	*Vitreochlamys sp.*
WDWX	Green Algae	Dunaliellaceae	*Dunaliella tertiolecta*
RHVC	Green Algae	Dunaliellaceae	*Dunaliella salina*
SYJM	Green Algae	Dunaliellaceae	*Dunaliella viridis dumsii*
UKUC	Green Algae	Dunaliellaceae	*Dunaliella salina*
ZDIZ	Green Algae	Dunaliellaceae	*Dunaliella tertiolecta*
FXHG	Green Algae	Dunaliellaceae	*Hafniomonas reticulata*
ODXI	Green Algae	Haematococcaceae	*Haematococcus pluvialis*
AGIO	Green Algae	Haematococcaceae	*Haematococcus pluvialis*
ZLQE	Green Algae	Haematococcaceae	*Stephanosphaera pluvialis*
ZIVZ	Green Algae	Phacotaceae	*Phacotus lenticularis*
LNIL	Green Algae	Phacotaceae	*Pteromonas angulosa*
ACRY	Green Algae	Phacotaceae	*Pteromonas sp.*
NKXU	Green Algae	Trebouxiaceae	*Trebouxia arboricola*

ETGN	Green Algae	Botryococcaceae	*Botryococcus braunii*
VJDZ	Green Algae	Botryococcaceae	*Botryococcus sudeticus*
QYXY	Green Algae	Botryococcaceae	*Botryococcus terribilis*
MWAN	Green Algae	Chlorellaceae	*Chlorella minutissima*
PFUD	Green Algae	Chlorellaceae	*Geminella sp.*
MFYC	Green Algae	Chlorellaceae	*Nannochloris atomus*
AKCR	Green Algae	Chlorellaceae	*Parachlorella kessleri*
BILC	Green Algae	Chlorellaceae	*Prototheca wickerhamii*
ZNUM	Green Algae	Leptosiraceae	*Leptosira obovata*
MNCB	Green Algae	Oocystaceae	*Eremosphaera viridis*
DXNY	Green Algae	Microthamniaceae	*Microthamnion kuetzingianum*
ZDOF	Green Algae	Microthamniaceae	*Microthamnion kuetzingianum*
WCLV	Green Algae	Prasiolaceae	*Prasiola crispa*
WXRI	Green Algae	Prasiolaceae	*Stichococcus bacillaris*
CQQP	Green Algae	Ulvaceae	*Ochlochaete sp.*
OAEZ	Green Algae	Ulvaceae	*Percursaria percursa*
LSHT	Green Algae	Bolbocoleonaceae	*Bolbocoleon piliferum*
PZBH	Green Algae	Oltmannsiellopsidaceae	*Oltmannsiellopsis viridis*
QJYX	Green Algae	Oltmannsiellopsidaceae	*Oltmannsiellopsis viridis*
OQON	Green Algae	Ulvellaceae	*Entocladia endozoica*
VBLH	Green Algae	Cladophoraceae	*Cladophora glomerata*
NATT	Green Algae	Trentepohliaceae	*Trentepohlia annulata*
YDCQ	Green Algae	Trentepohliaceae	*Cephaleuros virescens*
CBNG	Green Algae	Borodinellaceae	*Planophila laetevirens*
LETF	Green Algae	Borodinellaceae	*Planophila terrestris*
DZPJ	Green Algae	Cylindrocapsaceae	*Cylindrocapsa geminella*
JIWJ	Green Algae	Ulotrichaceae	*Acrosiphonia sp.*
KADG	Green Algae	Ulotrichaceae	*Ignatius tetrasporus*
FPCO	Green Algae	Ulotrichaceae	*Interfilum paradoxum*
JTIG	Green Algae	Bryopsidaceae	*Bryopsis plumosa*
GYBH	Green Algae	Codiaceae	*Codium fragile*
VHIJ	Green Algae	Chaetosiphonaceae	*Blastophysa cf. rhizopus*
KYIO	Green Algae	Mesostigmataceae	*Mesostigma viride*
RRSV	Green Algae	Pedinomonadaceae	*Pedinomonas minor*
PUAN	Green Algae	Pedinomonadaceae	*Pedinomonas tuberculata*
EGNB	Green Algae	Scourfieldiaceae	*Scourfieldia sp.*
PRIQ	Green Algae	Pleurastraceae	*Chlorococcum oleofaciens*
TGNL	Green Algae	incertae sedis	*Picocystis salinarum*
MWXT	Green Algae	Characeae	*Chara vulgaris*
QPDY	Green Algae	Coleochaetaceae	*Coleochaete irregularis*
VQBJ	Green Algae	Coleochaetaceae	*Coleochaete scutata*
DRGY	Green Algae	Chaetosphaeridiaceae	*Chaetosphaeridium globosum*
FQLP	Green Algae	Klebsormidiaceae	*Klebsormidium subtile*
BFIK	Green Algae	Klebsormidiaceae	*Entransia fimbriata*
JOJQ	Green Algae	Zygnemataceae	*Cylindrocystis cushleckae*
ZRMT	Green Algae	Zygnemataceae	*Mougeotia sp.*
HAOX	Green Algae	Zygnemataceae	*Spirogyra sp.*
WGMD	Green Algae	Zygnemataceae	*Zygnema sp.*
MFZO	Green Algae	Zygnemataceae	*Zygnemopsis sp.*
DRFX	Green Algae	Closteriaceae	*Closterium lunula*
DFDS	Green Algae	Desmidiaceae	*Desmidium aptogonum*
QWFV	Green Algae	Desmidiaceae	*Bambusina borreri*
HIDG	Green Algae	Desmidiaceae	*Cosmarium broomei*
MNNM	Green Algae	Desmidiaceae	*Cosmarium granatum*

STKJ	Green Algae	Desmidiaceae	*Cosmarium ochthodes*
HJVM	Green Algae	Desmidiaceae	*Cosmarium ochthodes*
WDGV	Green Algae	Desmidiaceae	*Cosmarium subtumidum*
BHBK	Green Algae	Desmidiaceae	*Cosmarium tinctum*
RQFE	Green Algae	Desmidiaceae	*Cosmocladium cf. constrictum*
GYRP	Green Algae	Desmidiaceae	*Euastrum affine*
MCHJ	Green Algae	Desmidiaceae	*Micrasterias fimbriata*
GGWH	Green Algae	Desmidiaceae	*Onychonema laeve*
RPQV	Green Algae	Desmidiaceae	*Phymatodocis nordstedtiana*
MOYY	Green Algae	Desmidiaceae	*Pleurotaenium trabecula*
ISHC	Green Algae	Desmidiaceae	*Staurastrum sebaldi*
WCQU	Green Algae	Desmidiaceae	*Staurodesmus convergens*
RPRU	Green Algae	Desmidiaceae	*Staurodesmus omearii*
GBGT	Green Algae	Desmidiaceae	*Xanthidium antilopaeum*
WSJO	Green Algae	Mesotaeniaceae	*Mesotaenium braunii*
HKZW	Green Algae	Mesotaeniaceae	*Mesotaenium caldariorum*
WDCW	Green Algae	Mesotaeniaceae	*Mesotaenium endlicherianum*
NBYP	Green Algae	Mesotaeniaceae	*Mesotaenium kramstae*
YOXI	Green Algae	Mesotaeniaceae	*Cylindrocystis brebissonii*
RPGL	Green Algae	Mesotaeniaceae	*Cylindrocystis brebissonii*
VAZE	Green Algae	Mesotaeniaceae	*Cylindrocystis sp.*
FFGR	Green Algae	Mesotaeniaceae	*Netrium digitus*
KMNX	Green Algae	Mesotaeniaceae	*Nucleotaenium eifelense*
SNOX	Green Algae	Mesotaeniaceae	*Planotaenium ohtanii*
XRTZ	Green Algae	Mesotaeniaceae	*Roya obtusa*
NNHQ	Green Algae	Mesotaeniaceae	*Spirotaenia minuta*
TPHT	Green Algae	Mesotaeniaceae	*Spirotaenia sp.*
YSQT	Green Algae	Peniaceae	*Penium exiguum*
AEKF	Green Algae	Peniaceae	*Penium margaritaceum*
KEYW	Green Algae	Gonatozygaceae	*Gonatozygon kinahanii*
POOW	Glaucophyta (Algae)	Glaucocystaceae	*Glaucocystis cf. nostochinearum*
QFND	Glaucophyta (Algae)	Glaucocystaceae	*Cyanophora paradoxa CCAC 0074 (M0763)*
YTYU	Glaucophyta (Algae)	Glaucocystaceae	*Cyanophora paradoxa CCAC 0091 (M0507/1)*
PQED	Glaucophyta (Algae)	Glaucocystaceae	*Gloeochaete wittrockiana*
JKHA	Glaucophyta (Algae)	incertae sedis	*Cyanoptyche gloeocystis*
OBUY	Red Algae	Porphyridiaceae	*Porphyridium cruentum*
PVGP	Red Algae	Porphyridiaceae	*Porphyridium purpureum*
RSOF	Red Algae	Glaucosphaeraceae	*Glaucosphaera vacuolata*
JJZR	Red Algae	Rhodochaetaceae	*Rhodochaete parvula*
LLXJ	Red Algae	Stylonemataceae	*Chroodactylon ornatum*
ZULJ	Red Algae	Bangiaceae	*Pyropia yezoensis*
VZWX	Red Algae	Ceramiaceae	*Ceramium kondoi*
YSBD	Red Algae	Dasyaceae	*Heterosiphonia pulchra*
XAXW	Red Algae	Rhodomelaceae	*Neosiphonia japonica*
UYFR	Red Algae	Rhodomelaceae	*Symphyocladia latiuscula*
IEHF	Red Algae	Dumontiaceae	*Dumontia simplex*
SBLT	Red Algae	Endocladiaceae	*Gloiopeltis furcata*
UGPM	Red Algae	Gigartinaceae	*Chondrus crispus*
WEJN	Red Algae	Gigartinaceae	*Mazzaella japonica*
BWVJ	Red Algae	Solieriaceae	*Betaphycus philippinensis*
JEBK	Red Algae	Solieriaceae	*Eucheuma denticulatum*
IHJY	Red Algae	Solieriaceae	*Kappaphycus alvarezii*

FTRP	Red Algae	Gracilariaceae	*Gracilaria chouae*
VNAL	Red Algae	Gracilariaceae	*Gracilaria vermiculophylla*
LJPN	Red Algae	Gracilariaceae	*Gracilaria blodgettii*
IKWM	Red Algae	Gracilariaceae	*Gracilaria lemaneiformis*
ZJOJ	Red Algae	Halymeniaceae	*Grateloupia filicina*
IKIZ	Red Algae	Halymeniaceae	*Grateloupia livida*
URSB	Red Algae	Halymeniaceae	*Grateloupia turuturu*
PYDB	Red Algae	Halymeniaceae	*Grateloupia catenata*
PWKQ	Red Algae	Halymeniaceae	*Gracilaria sp.*
RTLC	Red Algae	Rhodellaceae	*Rhodella violacea*
BAKF	Chromista (Algae)	Cryptomonadaceae	*Cryptomonas curvata*
ROZZ	Chromista (Algae)	Chroomonadaceae	*Chroomonas sp.*
MJMQ	Chromista (Algae)	Chroomonadaceae	*Hemiselmis virescens*
IRZA	Chromista (Algae)	Geminigeraceae	*Proteomonas sulcata*
IAYV	Chromista (Algae)	Pyrenomonadaceae	*Rhodomonas sp.*
BAJW	Chromista (Algae)	Isochrysidaceae	*Isochrysis sp.*
APTP	Chromista (Algae)	Ishigeaceae	*Ishige okamurae*
LXRN	Chromista (Algae)	Prymnesiaceae	*Prymnesium parvum*
NMAK	Chromista (Algae)	Pavlovaceae	*Pavlova lutheri*
RFAD	Chromista (Algae)	Pavlovaceae	*Pavlova lutheri CCAC 0028*
LLEN	Chromista (Algae)	Pavlovaceae	*Pavlova lutheri SAG 926-1*
RAPY	Chromista (Algae)	Laminariaceae	*Saccharina sculpera*
OGZM	Chromista (Algae)	Laminariaceae	*Saccharina japonica*
QDTV	Chromista (Algae)	Laminariaceae	*Saccharina japonica*
FIDQ	Chromista (Algae)	Alariacea	*Undaria pinnatifida*
EBWI	Chromista (Algae)	Chromulinaceae	*Ochromonas sp.*
JQFK	Chromista (Algae)	Monodopsidaceae	*Picochlorum atomus*
BOGT	Chromista (Algae)	Mallomonadaceae	*Mallomonas sp.*
VKVG	Chromista (Algae)	Mallomonadaceae	*Synura sp.*
DBYD	Chromista (Algae)	Mallomonadaceae	*Synura petersenii*
FSQE	Chromista (Algae)	Desmarestiaceae	*Desmarestia viridis*
QLMZ	Chromista (Algae)	Scytosiphonaceae	*Colpomenia sinuosa*
JCXF	Chromista (Algae)	Scytosiphonaceae	*Scytosiphon lomentaria*
ASZK	Chromista (Algae)	Chordariacea	*Punctaria latifolia*
ULXR	Chromista (Algae)	Scytosiphonacea	*Scytosiphon dotyi*
VRGZ	Chromista (Algae)	Scytosiphonacea	*Petalonia fascia*
LDRY	Chromista (Algae)	Sargassaceae	*Sargassum fusiforme*
VYER	Chromista (Algae)	Sargassaceae	*Sargassum hemiphyllum*
FIKG	Chromista (Algae)	Sargassaceae	*Sargassum henslowianum*
RWXW	Chromista (Algae)	Sargassaceae	*Sargassum horneri*
FOMH	Chromista (Algae)	Sargassaceae	*Sargassum integerrimum*
YRMA	Chromista (Algae)	Sargassaceae	*Sargassum thunbergii*
HFIK	Chromista (Algae)	Sargassaceae	*Sargassum vachellianum*
JGGD	Chromista (Algae)	Sargassacea	*Sargassum muticum*
TZJQ	Dinophyceae	Prorocentraceae	*Prorocentrum micans*
UNBZ	Euglenozoa	Euglenacaea	*Euglena sp.*

Apêndice 2A: Resultados gerados pelo programa Blast2GO, das sequências de algas verdes.

SeqName	Description	Length	#Hits	e-Value	sim mean	InterPro IDs
scaffold-QRTH-2029936-Chloromonas_perforata	cysteine proteinase inhibitor	93	20	3.33636E-61	91.04	IPR000010 (PFAM)
scaffold-NBYP-2009686-	cysteine proteinase	88	20	3.24326E-	74.49	IPR000010

Mesotaenium_kramstei	inhibitor A-like			24		(PFAM)
scaffold-MFZO-2022157-Zygnemopsis_sp	cysteine proteinase inhibitor A-like	88	20	1.34198E-27	76.76	IPR000010 (PFAM)
scaffold-NBYP-2009685-Mesotaenium_kramstei	cysteine proteinase inhibitor A-like	88	20	3.24326E-24	74.49	IPR000010 (PFAM)
scaffold-VAZE-2049209-Cylindrocystis_sp	cysteine proteinase inhibitor A-like	89	20	3.38643E-32	78.4	IPR000010 (PFAM)
scaffold-TPHT-2014347-Spirotaenia_sp	cysteine proteinase inhibitor	91	20	3.08603E-29	70.44	IPR000010 (PFAM)
scaffold-TPHT-2014348-Spirotaenia_sp	cysteine proteinase inhibitor	91	20	3.08603E-29	70.44	IPR000010 (PFAM)
scaffold-YOXI-2051266-Cylindrocystis_brebissonii-M2213	cysteine proteinase inhibitor A-like	89	20	5.35623E-32	77.59	IPR000010 (PFAM)
scaffold-RPGL-2008164-Cylindrocystis_brebissonii-M2853	cysteine proteinase inhibitor A-like	89	20	2.51937E-32	78.15	IPR000010 (PFAM)
scaffold-WDCW-2005545-Mesotaenium_endlicherianum	cysteine proteinase inhibitor A-like	108	20	8.24664E-29	73.49	IPR000010 (PFAM)
scaffold-RPQV-2004146-Phymatodocis_nordstedtiana	cysteine proteinase inhibitor-like	97	20	1.91007E-27	70.82	IPR000010 (PFAM)
scaffold-RPQV-2004148-Phymatodocis_nordstedtiana	cysteine proteinase inhibitor-like	97	20	1.91007E-27	70.82	IPR000010 (PFAM)
scaffold-VAZE-2007871-Cylindrocystis_sp	cysteine proteinase inhibitor A-like	86	20	3.00167E-29	78.25	IPR000010 (PFAM)
scaffold-WDCW-2005546-Mesotaenium_endlicherianum	cysteine proteinase inhibitor A-like	111	20	1.57042E-29	73.53	IPR000010 (PFAM)
scaffold-XRTZ-2001899-Roya_obtusa	cysteine proteinase inhibitor	85	20	2.2367E-25	73.29	IPR000010 (PFAM)
scaffold-XRTZ-2001900-Roya_obtusa	cysteine proteinase inhibitor	91	20	1.31267E-25	72.0	IPR000010 (PFAM)
scaffold-JOJQ-2007220-Cylindrocystis_cushleckae	cysteine proteinase inhibitor A-like	100	20	3.02023E-28	73.63	IPR000010 (PFAM)
scaffold-DRGY-2007207-Chaetosphaeridium_globosum	cysteine proteinase inhibitor A-like	92	20	1.22048E-27	73.96	IPR000010 (PFAM)
scaffold-YOXI-2051387-Cylindrocystis_brebissonii-M2213	cysteine proteinase inhibitor A-like	90	20	1.88568E-31	75.99	IPR000010 (PFAM)
scaffold-GGWH-2007719-Onychonema_laeve	cysteine proteinase inhibitor	91	20	3.11638E-25	66.78	IPR000010 (PFAM)
scaffold-JOJQ-2007221-Cylindrocystis_cushleckae	cysteine proteinase inhibitor A-like	97	20	6.04272E-28	73.92	IPR000010 (PFAM)
scaffold-RPRU-2040090-Staurodesmus_omearii	cysteine proteinase inhibitor	88	20	3.3601E-23	66.68	IPR000010 (PFAM)
scaffold-RPGL-2025924-Cylindrocystis_brebissonii-M2853	cysteine proteinase inhibitor A-like	84	20	1.87196E-25	75.12	IPR000010 (PFAM)
scaffold-JOJQ-2036724-Cylindrocystis_cushleckae	cysteine proteinase inhibitor 6	86	20	3.49198E-26	76.25	IPR000010 (PFAM)
scaffold-HKZW-2002046-Mesotaenium_caldariorum	cysteine proteinase inhibitor A-like	91	20	4.80491E-30	72.61	IPR000010 (PFAM)
scaffold-GGWH-2007720-Onychonema_laeve	cysteine proteinase inhibitor	91	20	3.11638E-25	66.78	IPR000010 (PFAM)
scaffold-YSQT-2008945-Penium_exiguum	cysteine proteinase inhibitor-like	89	20	2.07148E-20	64.42	IPR000010 (PFAM)
scaffold-ISHC-2043796-Staurastrum_sebaldi	cysteine proteinase inhibitor	87	20	1.62734E-24	71.65	IPR000010 (PFAM)
scaffold-QWFV-2000138-Bambusina_borreri	cysteine proteinase inhibitor	87	20	3.13713E-18	64.66	IPR000010 (PFAM)
scaffold-STKJ-2001132-	cysteine proteinase	88	20	7.79E-19	62.32	IPR000010

Zygnema_sp.-A	inhibitor					(PFAM)
scaffold-HJVM-2001476-Cosmarium_ochthodes	cysteine proteinase inhibitor	88	20	7.79E-19	62.32	IPR000010 (PFAM)
scaffold-HKZW-2002047-Mesotaenium_caldariorum	cysteine protease inhibitor	90	20	2.14075E-29	73.33	IPR000010 (PFAM)
scaffold-WSJO-2045235-Mesotaenium_braunii	cysteine proteinase inhibitor A-like	92	20	9.11307E-27	68.4	IPR000010 (PFAM)
scaffold-KEYW-2025821-Gonatozygon_kinahanii	cysteine proteinase inhibitor A-like	89	20	2.44115E-23	70.52	IPR000010 (PFAM)
scaffold-STKJ-2001133-Zygnema_sp.-A	cysteine proteinase inhibitor	88	20	7.79E-19	62.32	IPR000010 (PFAM)
scaffold-TPHT-2014345-Spirotaenia_sp	Cysteine proteinase inhibitor	88	20	9.72804E-24	66.75	IPR000010 (PFAM)
scaffold-TPHT-2014346-Spirotaenia_sp	Cysteine proteinase inhibitor	88	20	9.72804E-24	66.75	IPR000010 (PFAM)
scaffold-HJVM-2001477-Cosmarium_ochthodes	cysteine proteinase inhibitor	88	20	7.79E-19	62.32	IPR000010 (PFAM)
scaffold-MNNM-2042288-Cosmarium_granatum	cysteine proteinase inhibitor	90	20	5.65377E-24	67.39	IPR000010 (PFAM)
scaffold-WSJO-2007838-Mesotaenium_braunii	cysteine proteinase inhibitor	87	20	5.3379E-19	70.11	IPR000010 (PFAM)
scaffold-MCHJ-2061247-Micrasterias_fimbriata	cysteine proteinase inhibitor	80	20	1.29237E-16	69.73	IPR000010 (PFAM)
scaffold-MWXT-2004285-Chara_vulgaris	cysteine proteinase inhibitor 1	86	20	2.14557E-42	63.85	IPR000010 (PFAM)
scaffold-MWXT-2004289-Chara_vulgaris	cysteine proteinase inhibitor 1	86	20	2.14557E-42	63.85	IPR000010 (PFAM)
scaffold-MWXT-2004288-Chara_vulgaris	cysteine proteinase inhibitor 1	86	20	2.14557E-42	63.85	IPR000010 (PFAM)
scaffold-MWXT-2004286-Chara_vulgaris	cysteine proteinase inhibitor 1	86	20	2.14557E-42	63.85	IPR000010 (PFAM)
scaffold-ZRMT-2002729-Mougeotia_sp	cysteine proteinase inhibitor A-like	72	20	1.3273E-17	73.4	IPR000010 (PFAM)
scaffold-KEYW-2023121-Gonatozygon_kinahanii	cysteine proteinase inhibitor 3	84	20	2.9606E-21	66.73	IPR000010 (PFAM)
scaffold-WDGV-2002306-Cosmarium_subtumidum	unknown	77	1	3.65574E-11	71.43	IPR000010 (PFAM)
scaffold-QPDY-2027142-Coleochaete_irregularis	cysteine proteinase inhibitor	82	20	0	64.0	IPR000010 (PFAM)
scaffold-GBGT-2019490-Xanthidium_antilopaeum	cysteine proteinase inhibitor	82	20	6.31698E-24	69.68	IPR000010 (PFAM)
scaffold-GBGT-2019491-Xanthidium_antilopaeum	cysteine proteinase inhibitor	82	20	6.31698E-24	69.68	IPR000010 (PFAM)
scaffold-GBGT-2019489-Xanthidium_antilopaeum	cysteine proteinase inhibitor	82	20	6.31698E-24	69.68	IPR000010 (PFAM)
scaffold-WDGV-2002307-Cosmarium_subtumidum	cystein proteinase inhibitor	78	3	4.67002E-11	68.25	IPR000010 (PFAM)
scaffold-GYRP-2006661-Euastrum_affine	cysteine proteinase inhibitor 1	78	20	2.33332E-17	66.24	IPR000010 (PFAM)
scaffold-DFDS-2038389-Desmidium_aptogonum	cysteine proteinase inhibitor	87	20	1.54595E-20	64.54	IPR000010 (PFAM)
scaffold-QWFV-2075871-Bambusina_borreri	cysteine proteinase inhibitor A-like	74	20	1.00923E-16	66.65	IPR000010 (PFAM)
scaffold-HAOX-2024011-Spirogyra_sp	cysteine proteinase inhibitor A-like	95	20	6.00862E-26	68.12	IPR000010 (PFAM)
scaffold-WCQU-2008187-	Cysteine proteinase	88	20	8.29136E-	67.08	IPR000010

Staurodesmus_convergens	inhibitor			17		(PFAM)
scaffold-GYRP-2006663-Euastrum_affine	cysteine proteinase inhibitor A-like	70	20	8.22818E-17	68.61	IPR000010 (PFAM)
scaffold-GYRP-2006662-Euastrum_affine	cysteine proteinase inhibitor A-like	70	20	8.22818E-17	68.61	IPR000010 (PFAM)
scaffold-WCQU-2008188-Staurodesmus_convergens	Cysteine proteinase inhibitor	88	20	8.29136E-17	67.08	IPR000010 (PFAM)
scaffold-BFIK-2025023-Entransia_fimbriat	cysteine proteinase inhibitor	91	6	1.97416E-12	64.61	IPR000010 (PFAM)
scaffold-MCHJ-2060964-Micrasterias_fimbriata	cysteine proteinase inhibitor	89	20	1.17934E-17	59.53	IPR000010 (PFAM)
scaffold-BZSH-2002439-Golenkinia_longispicula	cysteine proteinase inhibitor A-like	79	20	4.71477E-15	65.76	IPR000010 (PFAM)
scaffold-GXBM-2002367-Coccomyxa_pringsheimii	cysteine proteinase inhibitor 1-like	86	7	1.73678E-49	66.05	IPR000010 (PFAM)
scaffold-GXBM-2002368-Coccomyxa_pringsheimii	cysteine proteinase inhibitor 1-like	86	7	1.73678E-49	66.05	IPR000010 (PFAM)
scaffold-BZSH-2002438-Golenkinia_longispicula	cysteine proteinase inhibitor A-like	76	20	5.69369E-15	66.29	IPR000010 (PFAM)

Apêndice 2B: Resultados gerados pelo programa Blast2GO, das sequências de briófitas.

SeqName	Description	Length	#Hits	e-Value	sim mean	InterPro IDs
scaffold-LFVP-2004953-LFVP-Marchantia_paleacea-2_samples_combined	cysteine proteinase inhibitor	87	20	9.4071E-40	75.56	IPR000010 (PFAM)
scaffold-LFVP-2004955-LFVP-Marchantia_paleacea-2_samples_combined	cysteine proteinase inhibitor	87	20	9.4071E-40	75.56	IPR000010 (PFAM)
scaffold-LFVP-2004954-LFVP-Marchantia_paleacea-2_samples_combined	cysteine inhibitor 1	81	20	8.41604E-35	74.37	IPR000010 (PFAM)
scaffold-TFDQ-2008546-Monoclea_gottschei	cysteine proteinase inhibitor A-like	93	20	1.95327E-51	88.66	IPR000010 (PFAM)
scaffold-HERT-2005449-Sphaerocarpos_texanus	cysteine proteinase inhibitor	90	20	3.22486E-30	77.48	IPR000010 (PFAM)
scaffold-HERT-2005451-Sphaerocarpos_texanus	cysteine proteinase inhibitor	90	20	3.22486E-30	77.48	IPR000010 (PFAM)
scaffold-QKQO-2046228-Pseudotaxiphyllum_elegans	cysteine proteinase inhibitor A-like	88	20	9.60268E-38	73.21	IPR000010 (PFAM)
scaffold-RGKI-2007331-Leucobryum_glaucum	cysteine proteinase inhibitor A-like	88	20	1.74536E-34	76.01	IPR000010 (PFAM)
scaffold-VMXJ-2126173-Leucobryum_albidum	cysteine proteinase inhibitor A-like	88	20	1.74536E-34	76.01	IPR000010 (PFAM)
scaffold-TFDQ-2008547-Monoclea_gottschei	cysteine proteinase inhibitor A-like	92	20	1.53732E-50	88.19	IPR000010 (PFAM)
scaffold-JADL-2045067-Rhynchostegium_serrulatum	cysteine proteinase inhibitor A-like	87	20	1.26601E-37	75.76	IPR000010 (PFAM)
scaffold-WSPM-2044186-Rhytidiadelphus_loreus	cysteine proteinase inhibitor A-like	88	20	5.88015E-41	73.21	IPR000010 (PFAM)
scaffold-RCBT-2185197-Sphagnum_palustre	cysteine proteinase inhibitor 6-like	96	20	5.32296E-35	79.83	IPR000010 (PFAM)
scaffold-HERT-2005450-Sphaerocarpos_texanus	cysteine proteinase inhibitor	90	20	3.22486E-30	77.48	IPR000010 (PFAM)
scaffold-TAVP-2017134-	cysteine proteinase	88	20	0	71.86	IPR000010

Calliergon_cordifolium	inhibitor A-like					(PFAM)
scaffold-RTMU-2011540-Calypogeia_fissa	cysteine proteinase inhibitor A-like	92	20	6.1956E-25	74.61	IPR000010 (PFAM)
scaffold-QMWB-2005435-Anomodon_attenuatus	cysteine proteinase inhibitor A-like	88	20	6.05281E-40	74.36	IPR000010 (PFAM)
scaffold-VBMM-2050119-Anomodon_rostratus	cysteine proteinase inhibitor A-like	88	20	9.65817E-42	73.39	IPR000010 (PFAM)
scaffold-MIRS-2084743-Climacium_dendroides	cysteine proteinase inhibitor A-like	88	20	3.56424E-39	74.39	IPR000010 (PFAM)
scaffold-TXVB-2072260-Lunularia_cruciata	cysteine proteinase inhibitor	120	20	1.64491E-56	73.07	IPR000010 (PFAM)
scaffold-TMAJ-2179486-Neckera_douglasii	cysteine proteinase inhibitor A-like	88	20	1.3457E-39	74.25	IPR000010 (PFAM)
scaffold-LGOW-2011419-Schistochila_sp	Cysteine proteinase inhibitor 12	93	20	9.24392E-34	76.37	IPR000010 (PFAM)
scaffold-KRUQ-2012852-Porella_navicularis	cysteine proteinase inhibitor	95	20	1.18352E-38	75.12	IPR000010 (PFAM)
scaffold-KRUQ-2012849-Porella_navicularis	cysteine proteinase inhibitor	95	20	1.18352E-38	75.12	IPR000010 (PFAM)
scaffold-GOWD-2019384-Sphagnum_lescurii	cysteine protease inhibitor	78	20	1.04026E-33	81.98	IPR000010 (PFAM)
scaffold-IGUH-2159625-Schwetschkeopsis_fabronia	cysteine proteinase inhibitor A-like	88	20	4.2807E-41	73.68	IPR000010 (PFAM)
scaffold-ZACW-2096043-Leucodon_sciuroides	cysteine proteinase inhibitor A-like	88	20	4.2807E-41	73.68	IPR000010 (PFAM)
scaffold-LNSF-2065621-Hypnum_subimponens	cysteine proteinase inhibitor A-like	88	20	4.95275E-42	73.18	IPR000010 (PFAM)
scaffold-MIRS-2083994-Climacium_dendroides	cysteine protease inhibitor	95	20	7.41393E-30	65.45	IPR000010 (PFAM)
scaffold-NGTD-2003224-Dicranum_scoparium	cysteine proteinase inhibitor 6-like	93	20	3.25353E-31	69.75	IPR000010 (PFAM)
scaffold-CMEQ-2001993-Orthotrichum_lyellii	cysteine proteinase inhibitor 6-like	90	20	1.41471E-37	72.98	IPR000010 (PFAM)
scaffold-CMEQ-2001994-Orthotrichum_lyellii	cysteine proteinase inhibitor 6-like	90	20	1.41471E-37	72.98	IPR000010 (PFAM)
scaffold-UUHD-2007234-Porella_pinnata	cysteine proteinase inhibitor	96	20	4.83903E-40	76.74	IPR000010 (PFAM)
scaffold-HVBQ-2128747-Tetraphis_pellucida	cysteine proteinase inhibitor A-like	90	20	8.48415E-41	77.84	IPR000010 (PFAM)
scaffold-DHWX-2010955-Fontinalis_antipyretica	cysteine proteinase inhibitor A-like	88	20	2.8755E-40	73.63	IPR000010 (PFAM)
scaffold-WJLO-2000597-Riccia_berychiana	cysteine proteinase inhibitor	93	20	5.64589E-30	73.41	IPR000010 (PFAM)
scaffold-ORKS-2009074-Philonotis_fontana	cysteine proteinase inhibitor A-like	88	20	1.82363E-45	74.24	IPR000010 (PFAM)
scaffold-ORKS-2009073-Philonotis_fontana	cysteine proteinase inhibitor A-like	88	20	1.82363E-45	74.24	IPR000010 (PFAM)
scaffold-WNGH-2085150-Aulacomnium_heterostichum	cysteine proteinase inhibitor A-like	90	20	9.30936E-39	73.58	IPR000010 (PFAM)
scaffold-JMXW-2040905-Bryum_argenteum	cysteine proteinase inhibitor A-like	88	20	4.91633E-40	71.67	IPR000010 (PFAM)
scaffold-GOWD-2014352-Sphagnum_lescurii	cysteine proteinase inhibitor 6-like	93	20	3.7754E-27	76.68	IPR000010 (PFAM)
scaffold-XWHK-2045704-Funaria	cysteine proteinase inhibitor A-like	88	20	9.72924E-41	72.05	IPR000010 (PFAM)
scaffold-EEMJ-2036252-	cysteine proteinase	88	20	2.07062E-	72.38	IPR000010

Thuidium_delicatulum	inhibitor A-like			40		(PFAM)
scaffold-LGOW-2011418-Schistochila_sp	Cysteine proteinase inhibitor 12	92	20	4.55663E-33	76.68	IPR000010 (PFAM)
scaffold-KEFD-2058520-Encalypta_streptocarpa	cysteine proteinase inhibitor A-like	90	20	3.20451E-51	75.47	IPR000010 (PFAM)
scaffold-PIUF-2008236-Pellia_cf._Epiphylla	Cysteine proteinase inhibitor 12	125	20	6.96247E-36	72.96	IPR000010 (PFAM)
scaffold-PIUF-2008237-Pellia_cf._Epiphylla	Cysteine proteinase inhibitor 12	125	20	6.96247E-36	72.96	IPR000010 (PFAM)
scaffold-PIUF-2008238-Pellia_cf._Epiphylla	Cysteine proteinase inhibitor 12	125	20	6.96247E-36	72.96	IPR000010 (PFAM)
scaffold-CHJJ-2010953-Lejeuneaceae_sp	cysteine proteinase inhibitor 3-like	88	20	5.21038E-32	75.82	IPR000010 (PFAM)
scaffold-RTMU-2011541-Calypogeia_fissa	cysteine proteinase inhibitor A-like	89	20	4.28839E-24	74.83	IPR000010 (PFAM)
scaffold-BGXB-2076402-Plagiomnium_insigne	cysteine proteinase inhibitor A-like	89	20	5.26351E-45	73.2	IPR000010 (PFAM)
scaffold-DXOU-2006128-Nothoceros_aenigmaticus	cysteine proteinase inhibitor	93	20	1.36865E-27	71.69	IPR000010 (PFAM)
scaffold-QKQO-2045914-Pseudotaxiphyllum_elegans	cysteine proteinase inhibitor A-like	95	20	3.7864E-30	67.58	IPR000010 (PFAM)
scaffold-TAVP-2004450-Calliergon_cordifolium	cysteine proteinase inhibitor A-like	95	20	9.25168E-29	66.04	IPR000010 (PFAM)
scaffold-FFPD-2012478-Ceratodon_purpureus	cysteine proteinase inhibitor A-like	96	20	4.24962E-52	73.79	IPR000010 (PFAM)
scaffold-UUHD-2007235-Porella_pinnata	cysteine proteinase inhibitor	89	20	8.87491E-39	78.1	IPR000010 (PFAM)
scaffold-TAVP-2004449-Calliergon_cordifolium	cysteine proteinase inhibitor A-like	95	20	9.25168E-29	66.04	IPR000010 (PFAM)
scaffold-SKQD-2012376-Takakia_lepidozioides	cysteine inhibitor 1	92	20	1.41082E-25	74.14	IPR000010 (PFAM)
scaffold-IRBN-2006002-Scapania_nemorosa	cysteine proteinase inhibitor A-like	92	20	8.99908E-39	75.19	IPR000010 (PFAM)
scaffold-IRBN-2006001-Scapania_nemorosa	cysteine proteinase inhibitor A-like	92	20	8.99908E-39	75.19	IPR000010 (PFAM)
scaffold-RDOO-2017879-Racomitrium_varium	cysteine proteinase inhibitor A-like	88	20	2.0242E-43	73.92	IPR000010 (PFAM)
scaffold-WNGH-2085708-Aulacomnium_heterostichum	cysteine proteinase inhibitor A-like	88	20	1.53046E-45	72.91	IPR000010 (PFAM)
scaffold-UHLI-2016614-Sphagnum_recurvatum	cysteine proteinase inhibitor 6-like	92	20	6.30018E-26	75.77	IPR000010 (PFAM)
scaffold-YEPO-2076688-cf._Physcomicromitrium_sp	cysteine proteinase inhibitor A-like	90	20	1.88793E-53	78.03	IPR000010 (PFAM)
scaffold-GOWD-2011650-Sphagnum_lescurii	cysteine proteinase inhibitor A-like	98	20	5.86548E-58	80.74	IPR000010 (PFAM)
scaffold-RGKI-2010169-Leucobryum_glaucum	cysteine proteinase inhibitor A-like	88	20	1.3448E-46	74.29	IPR000010 (PFAM)
scaffold-HVBQ-2125200-Tetraphis_pellucida	cysteine proteinase inhibitor A-like	88	20	1.37973E-43	73.81	IPR000010 (PFAM)
scaffold-JADL-2044003-Rhynchostegium_serrulatum	cysteine protease inhibitor	95	20	5.33591E-32	66.79	IPR000010 (PFAM)
scaffold-GOWD-2014353-Sphagnum_lescurii	cysteine proteinase inhibitor 6-like	91	20	4.87761E-27	76.65	IPR000010 (PFAM)
scaffold-RDOO-2002048-Racomitrium_varium	cysteine proteinase inhibitor A-like	88	20	8.3195E-48	75.17	IPR000010 (PFAM)
scaffold-UHLI-2021371-	cysteine proteinase	80	20	1.89631E-	80.34	IPR000010

Sphagnum_recurvatum	inhibitor			30		(PFAM)
scaffold-FFPD-2012477-Ceratodon_purpureus	cysteine proteinase inhibitor A-like	90	20	2.05918E-48	74.44	IPR000010 (PFAM)
scaffold-YEPO-2076541-cf._Physcomicromitrium_sp	cysteine proteinase inhibitor A-like	88	20	1.03132E-55	74.32	IPR000010 (PFAM)
scaffold-XWHK-2045439-Funaria	cysteine proteinase inhibitor 6-like	91	20	2.72669E-35	68.88	IPR000010 (PFAM)
scaffold-UHLI-2020310-Sphagnum_recurvatum	cysteine proteinase inhibitor 6-like	88	20	1.58187E-30	73.55	IPR000010 (PFAM)
scaffold-UHLI-2020309-Sphagnum_recurvatum	cysteine proteinase inhibitor 6-like	88	20	1.58187E-30	73.55	IPR000010 (PFAM)
scaffold-JMXW-2038855-Bryum_argenteum	cysteine proteinase inhibitor 6-like	90	20	8.46976E-35	68.81	IPR000010 (PFAM)
scaffold-KEFD-2009039-Encalypta_streptocarpa	cysteine proteinase inhibitor A-like	90	20	1.17506E-44	77.86	IPR000010 (PFAM)
scaffold-WJLO-2005073-Riccia_berychiana	cysteine proteinase inhibitor	93	20	1.61714E-49	73.92	IPR000010 (PFAM)
scaffold-ABCD-2010763-Niphotrichum_elongatum	cysteine proteinase inhibitor A-like	90	20	2.59193E-48	74.87	IPR000010 (PFAM)
scaffold-RCBT-2018697-Sphagnum_palustre	cysteine proteinase inhibitor 6-like	91	20	8.10807E-26	75.32	IPR000010 (PFAM)
scaffold-VMXJ-2000130-Leucobryum_albidum	cysteine proteinase inhibitor 6-like	95	20	1.42038E-29	66.38	IPR000010 (PFAM)
scaffold-RCBT-2003187-Sphagnum_palustre	cysteine proteinase inhibitor 6-like	91	20	5.51467E-33	72.73	IPR000010 (PFAM)
scaffold-HVBQ-2125838-Tetraphis_pellucida	cysteine proteinase inhibitor A-like	95	20	4.04082E-30	65.75	IPR000010 (PFAM)
scaffold-FFPD-2012479-Ceratodon_purpureus	cysteine proteinase inhibitor A-like	96	20	4.78147E-50	74.89	IPR000010 (PFAM)
scaffold-CMEQ-2080792-Orthotrichum_lyellii	cysteine proteinase inhibitor A-like	87	20	4.13515E-43	73.62	IPR000010 (PFAM)
scaffold-VBMM-2049218-Anomodon_rostratus	cysteine protease inhibitor	95	20	1.89885E-31	66.75	IPR000010 (PFAM)
scaffold-RDOO-2002046-Racomitrium_varium	cysteine proteinase inhibitor A-like	96	20	2.1325E-53	74.28	IPR000010 (PFAM)
scaffold-SZYG-2009047-Polytrichum_commune-gametophyte	cysteine proteinase inhibitor A-like	89	20	3.7252E-33	74.76	IPR000010 (PFAM)
scaffold-TGKW-2009732-Frullania	putative cysteine proteinase inhibitor B (cystatin B)	88	20	1.07398E-26	75.92	IPR000010 (PFAM)
scaffold-BGXB-2003214-Plagiomnium_insigne	cysteine proteinase inhibitor	90	20	1.26006E-36	72.36	IPR000010 (PFAM)
scaffold-ZQRI-2012280-Timmia_austriaca	cysteine proteinase inhibitor A-like	88	20	0	75.01	IPR000010 (PFAM)
scaffold-HVBQ-2008619-Tetraphis_pellucida	cysteine protease inhibitor	80	20	4.72745E-35	78.99	IPR000010 (PFAM)
scaffold-WJLO-2005074-Riccia_berychiana	cysteine proteinase inhibitor	87	20	6.02412E-47	74.38	IPR000010 (PFAM)
scaffold-SZYG-2041372-Polytrichum_commune-gametophyte	cysteine proteinase inhibitor 6-like	96	20	1.62128E-46	74.6	IPR000010 (PFAM)
scaffold-NGTD-2009620-Dicranum_scoparium	cysteine proteinase inhibitor 6-like	90	20	2.37803E-49	75.09	IPR000010 (PFAM)
scaffold-UHLI-2016615-Sphagnum_recurvatum	cysteine proteinase inhibitor 6-like	91	20	6.89487E-26	75.77	IPR000010 (PFAM)

scaffold-YWNF-2047866-Hedwigia_ciliata	cysteine proteinase inhibitor A-like	96	20	6.4606E-47	72.76	IPR000010 (PFAM)
scaffold-KEFD-2009040-Encalypta_streptocarpa	cysteine proteinase inhibitor A-like	90	20	1.17506E-44	77.86	IPR000010 (PFAM)
scaffold-KRUQ-2012850-Porella_navicularis	cysteine proteinase inhibitor	86	20	1.63969E-36	76.04	IPR000010 (PFAM)
scaffold-FITN-2004970-Treubia_lacunose	Cysteine proteinase inhibitor 6 like	91	20	2.33443E-26	71.43	IPR000010 (PFAM)
scaffold-QMWB-2057440-Anomodon_attenuatus	cysteine protease inhibitor	95	20	1.76384E-32	67.0	IPR000010 (PFAM)
scaffold-ZTHV-2081931-Atrichum_angustatum	cysteine proteinase inhibitor 6-like	96	20	5.66484E-47	75.84	IPR000010 (PFAM)
scaffold-CHJJ-2010951-Lejeuneaceae_sp	Cysteine proteinase inhibitor 12	85	20	1.68181E-23	76.23	IPR000010 (PFAM)
scaffold-TCBC-2013516-Megaceros_vincentianus	cysteine proteinase inhibitor	90	20	7.27702E-26	71.5	IPR000010 (PFAM)
scaffold-WSPM-2042882-Rhytidiadelphus_loreus	cysteine protease inhibitor	95	20	8.9825E-32	67.79	IPR000010 (PFAM)
scaffold-TMAJ-2177571-Neckera_douglasii	cysteine proteinase inhibitor A-like	95	20	8.78968E-32	66.7	IPR000010 (PFAM)
scaffold-TGKW-2009731-Frullania	cysteine proteinase inhibitor A-like	91	20	4.05518E-28	75.75	IPR000010 (PFAM)
scaffold-JPYU-2004649-Marchantia_polymorpha	cysteine proteinase inhibitor	87	20	1.02594E-55	76.58	IPR000010 (PFAM)
scaffold-JPYU-2004652-Marchantia_polymorpha	cysteine proteinase inhibitor	87	20	1.02594E-55	76.58	IPR000010 (PFAM)
scaffold-LNSF-2064059-Hypnum_subimponens	cysteine proteinase inhibitor A-like	95	20	9.79698E-32	66.87	IPR000010 (PFAM)
scaffold-ILBQ-2044252-Conocephalum_conicum	cysteine proteinase inhibitor	87	20	1.37882E-46	74.76	IPR000010 (PFAM)
scaffold-RGKI-2062405-Leucobryum_glaucum	cysteine proteinase inhibitor	90	20	1.2715E-48	73.49	IPR000010 (PFAM)
scaffold-VMXJ-2127411-Leucobryum_albidum	cysteine proteinase inhibitor	90	20	1.2715E-48	73.49	IPR000010 (PFAM)
scaffold-OFTV-2013736-Barbilophozia_barbata	cysteine proteinase inhibitor A-like	88	20	2.51825E-36	74.18	IPR000010 (PFAM)
scaffold-ZQRI-2012183-Timmia_austriaca	cysteine proteinase inhibitor A-like	90	20	1.97385E-49	72.35	IPR000010 (PFAM)
scaffold-BNCU-2084976-Radula_lindenbergia	putative cysteine proteinase inhibitor B (cystatin B)	89	20	6.73553E-27	73.3	IPR000010 (PFAM)
scaffold-AWOI-2069256-Diphyscium_foliosum	cysteine proteinase inhibitor A-like	90	20	2.11069E-50	73.88	IPR000010 (PFAM)
scaffold-JPYU-2004651-Marchantia_polymorpha	cysteine proteinase inhibitor	87	20	1.02594E-55	76.58	IPR000010 (PFAM)
scaffold-SZYG-2009049-Polytrichum_commune-gametophyte	cysteine proteinase inhibitor A-like	90	20	9.97886E-34	74.18	IPR000010 (PFAM)
scaffold-HMHL-2006230-Marchantia_paleacea-non_mycorrizal	cysteine proteinase inhibitor	87	20	9.4071E-40	75.56	IPR000010 (PFAM)
scaffold-IHWO-2006846-Marchantia_paleacea-mycorrizal	cysteine proteinase inhibitor	87	20	9.4071E-40	75.56	IPR000010 (PFAM)
scaffold-ZACW-2095198-Leucodon_sciuroides	cysteine protease inhibitor	95	20	2.41633E-32	66.93	IPR000010 (PFAM)
scaffold-IGUH-2162871-	cysteine protease	95	20	2.41633E-	66.93	IPR000010

Schwetschkeopsis_fabronia	inhibitor			32		(PFAM)
scaffold-EEMJ-2034540-Thuidium_delicatulum	cysteine protease inhibitor	95	20	1.79861E-31	68.51	IPR000010 (PFAM)
scaffold-DHWX-2002001-Fontinalis_antipyretica	cysteine protease inhibitor	94	20	1.37673E-26	64.0	IPR000010 (PFAM)
scaffold-PIUF-2003790-Pellia_cf._Epiphylla	cysteine proteinase inhibitor A-like	94	20	2.10798E-29	72.78	IPR000010 (PFAM)
scaffold-PIUF-2003789-Pellia_cf._Epiphylla	cysteine proteinase inhibitor A-like	94	20	2.10798E-29	72.78	IPR000010 (PFAM)
scaffold-FITN-2004971-Treubia_lacunose	Cysteine proteinase inhibitor 6 like	91	20	2.33443E-26	71.43	IPR000010 (PFAM)
scaffold-JPYU-2004650-Marchantia_polymorpha	cysteine proteinase inhibitor	87	20	1.02594E-55	76.58	IPR000010 (PFAM)
scaffold-DHWX-2002000-Fontinalis_antipyretica	cysteine protease inhibitor	94	20	4.32937E-26	67.25	IPR000010 (PFAM)
scaffold-YBQN-2011859-Odontoschisma_prostratum	Cysteine proteinase inhibitor 12	89	20	1.40056E-38	77.18	IPR000010 (PFAM)
scaffold-JHFI-2012129-Pellia_neesiana	cysteine proteinase inhibitor A	94	20	1.91088E-32	73.18	IPR000010 (PFAM)
scaffold-IHWO-2006847-Marchantia_paleacea-mycorrizal	cysteine proteinase inhibitor	87	20	9.4071E-40	75.56	IPR000010 (PFAM)
scaffold-HMHL-2006231-Marchantia_paleacea-non_mycorrizal	cysteine proteinase inhibitor	87	20	9.4071E-40	75.56	IPR000010 (PFAM)
scaffold-JHFI-2012130-Pellia_neesiana	cysteine proteinase inhibitor 12-like	89	20	4.72155E-31	73.81	IPR000010 (PFAM)
scaffold-HVBQ-2008617-Tetraphis_pellucida	cysteine protease inhibitor	75	20	6.77897E-32	78.48	IPR000010 (PFAM)
scaffold-JHFI-2012131-Pellia_neesiana	Cysteine proteinase inhibitor 12	88	20	6.33961E-31	73.97	IPR000010 (PFAM)
scaffold-CHJJ-2010952-Lejeuneaceae_sp	cysteine proteinase inhibitor 3-like	76	20	8.18202E-19	78.82	IPR000010 (PFAM)
scaffold-BPSG-2014883-Scouleria_aquatica	cysteine protease inhibitor	89	17	5.24066E-21	70.56	IPR000010 (PFAM)
scaffold-NRWZ-2082251-Metzgeria_crassipilis	cysteine proteinase inhibitor 6-like	89	20	1.43304E-26	67.72	IPR000010 (PFAM)
scaffold-YEPO-2077370-cf._Physcomicromitrium_sp	cysteine proteinase inhibitor A-like	91	20	1.1092E-57	75.71	IPR000010 (PFAM)
scaffold-VMXJ-2117007-Leucobryum_albidum	cysteine proteinase inhibitor	80	20	1.63605E-39	74.49	IPR000010 (PFAM)
scaffold-YWNF-2010546-Hedwigia_ciliata	cysteine proteinase inhibitor A-like	90	20	6.81387E-32	69.83	IPR000010 (PFAM)
scaffold-TFYI-2002774-Marchantia_emarginata	cysteine proteinase inhibitor	119	20	4.00877E-70	71.6	IPR000010 (PFAM)
scaffold-TFYI-2002777-Marchantia_emarginata	cysteine proteinase inhibitor	119	20	4.00877E-70	71.6	IPR000010 (PFAM)
scaffold-NGTD-2000698-Dicranum_scoparium	cysteine protease inhibitor	87	20	1.07947E-38	76.69	IPR000010 (PFAM)
scaffold-LGOW-2015800-Schistochila_sp	Cysteine proteinase inhibitor 12	91	20	8.4805E-27	73.81	IPR000010 (PFAM)
scaffold-LGOW-2015801-Schistochila_sp	Cysteine proteinase inhibitor 12	91	20	8.4805E-27	73.81	IPR000010 (PFAM)
scaffold-KEFD-2009651-Encalypta_streptocarpa	cysteine proteinase inhibitor A-like	91	20	1.22443E-53	73.95	IPR000010 (PFAM)
scaffold-NRWZ-2098299-Metzgeria_crassipilis	Cysteine proteinase inhibitor 12	76	20	7.84038E-19	76.2	IPR000010 (PFAM)

scaffold-ZFRE-2112727-Phaeoceros_carolinianus-sporophyte_1575	cysteine proteinase inhibitor	92	20	2.73133E-18	65.25	IPR000010 (PFAM)
scaffold-TFYI-2002776-Marchantia_emarginata	cysteine proteinase inhibitor	87	20	0	74.55	IPR000010 (PFAM)
scaffold-TFYI-2002775-Marchantia_emarginata	cysteine proteinase inhibitor	87	20	0	74.55	IPR000010 (PFAM)
scaffold-IGUH-2008923-Schwetschkeopsis_fabronia	cysteine proteinase inhibitor	95	20	6.53382E-46	72.75	IPR000010 (PFAM)
scaffold-TFDQ-2117991-Monoclea_gottschei	cysteine proteinase inhibitor 3-like	88	20	4.94919E-38	69.49	IPR000010 (PFAM)
scaffold-GRKU-2074261-Syntrichia_princeps	cysteine proteinase inhibitor	80	20	6.78403E-13	65.07	IPR000010 (PFAM)
scaffold-RXRQ-2007909-Phaeoceros_carolinianus-sporophyte	cysteine proteinase inhibitor A-like	92	20	1.78106E-25	69.1	IPR000010 (PFAM)
scaffold-TWUW-2047237-Anthoceros_agrestis-A	cysteine proteinase inhibitor A-like	89	20	1.23889E-24	69.03	IPR000010 (PFAM)
scaffold-BSNI-2047531-Anthoceros_agrestis-B	cysteine proteinase inhibitor A-like	89	20	1.23889E-24	69.03	IPR000010 (PFAM)
scaffold-HVBQ-2014633-Tetraphis_pellucida	cysteine proteinase inhibitor A-like	95	20	6.28387E-49	74.87	IPR000010 (PFAM)
scaffold-HPXA-2133243-Ptilidium_pulcherrimum	cysteine proteinase inhibitor	95	20	9.27404E-28	78.21	IPR000010 (PFAM)
scaffold-JADL-2004393-Rhynchostegium_serrulatum	cysteine proteinase inhibitor	95	20	1.11431E-47	72.26	IPR000010 (PFAM)
scaffold-KEFD-2009653-Encalypta_streptocarpa	cysteine proteinase inhibitor A-like	90	20	1.25453E-53	74.04	IPR000010 (PFAM)
scaffold-VMXJ-2001610-Leucobryum_albidum	cysteine proteinase inhibitor A-like	90	20	1.08361E-46	76.94	IPR000010 (PFAM)
scaffold-FITN-2010921-Treubia_lacunose	---NA---	78				IPR000010 (PFAM)
scaffold-CMEQ-2005502-Orthotrichum_lyellii	cysteine proteinase inhibitor	90	20	8.62425E-46	72.12	IPR000010 (PFAM)
scaffold-JMXW-2002543-Bryum_argenteum	cysteine proteinase inhibitor A-like	94	20	1.48955E-46	73.56	IPR000010 (PFAM)
scaffold-KEFD-2009652-Encalypta_streptocarpa	cysteine proteinase inhibitor A-like	90	20	1.25453E-53	74.04	IPR000010 (PFAM)
scaffold-ORKS-2006338-Philonotis_fontana	cysteine proteinase inhibitor A-like	90	20	2.63255E-51	74.45	IPR000010 (PFAM)
scaffold-ORKS-2006336-Philonotis_fontana	cysteine proteinase inhibitor A-like	90	20	2.63255E-51	74.45	IPR000010 (PFAM)
scaffold-ORKS-2006337-Philonotis_fontana	cysteine proteinase inhibitor A-like	90	20	2.63255E-51	74.45	IPR000010 (PFAM)
scaffold-ABCD-2074242-Niphotrichum_elongatum	cysteine proteinase inhibitor A-like	90	20	2.51945E-51	75.64	IPR000010 (PFAM)
scaffold-FITN-2086217-Treubia_lacunose	cysteine proteinase inhibitor 5-like	71	20	6.7051E-15	67.78	IPR000010 (PFAM)
scaffold-WNGH-2084702-Aulacomnium_heterostichum	cysteine proteinase inhibitor 6-like	90	20	2.8402E-47	74.22	IPR000010 (PFAM)
scaffold-ZQRI-2010041-Timmia_austriaca	cysteine proteinase inhibitor	90	20	9.17017E-48	72.54	IPR000010 (PFAM)
scaffold-RDOO-2014071-Racomitrium_varium	cysteine proteinase inhibitor A-like	90	20	1.27204E-52	75.3	IPR000010 (PFAM)
scaffold-TMAJ-2019727-Neckera_douglasii	cysteine proteinase inhibitor	90	20	1.11988E-46	72.98	IPR000010 (PFAM)

scaffold-MIRS-2008032-Climacium_dendroides	cysteine proteinase inhibitor	90	20	5.78325E-48	73.14	IPR000010 (PFAM)
scaffold-ZACW-2006653-Leucodon_sciuroides	cysteine proteinase inhibitor	88	20	6.12806E-44	72.65	IPR000010 (PFAM)
scaffold-RDOO-2014072-Racomitrium_varium	cysteine proteinase inhibitor A-like	90	20	2.16569E-54	75.73	IPR000010 (PFAM)
scaffold-ZACW-2006654-Leucodon_sciuroides	cysteine proteinase inhibitor	90	20	1.50939E-45	72.89	IPR000010 (PFAM)
scaffold-QKQO-2008111-Pseudotaxiphyllum_elegans	cysteine proteinase inhibitor A-like	91	20	6.85929E-49	73.47	IPR000010 (PFAM)
scaffold-XWHK-2045295-Funaria	cysteine proteinase inhibitor A-like	88	20	8.35221E-52	74.31	IPR000010 (PFAM)
scaffold-MIRS-2008031-Climacium_dendroides	cysteine proteinase inhibitor A-like	88	20	9.25992E-46	72.4	IPR000010 (PFAM)
scaffold-JADL-2004395-Rhynchostegium_serrulatum	cysteine proteinase inhibitor	95	20	1.11431E-47	72.26	IPR000010 (PFAM)
scaffold-CMEQ-2005503-Orthotrichum_lyellii	cysteine proteinase inhibitor	90	20	8.62425E-46	72.12	IPR000010 (PFAM)
scaffold-CMEQ-2005501-Orthotrichum_lyellii	cysteine proteinase inhibitor	90	20	8.62425E-46	72.12	IPR000010 (PFAM)
scaffold-QMWB-2008409-Anomodon_attenuatus	cysteine proteinase inhibitor	90	20	4.31003E-47	72.21	IPR000010 (PFAM)
scaffold-ORKS-2010000-Philonotis_fontana	cysteine proteinase inhibitor A-like	76	20	5.89829E-29	68.83	IPR000010 (PFAM)
scaffold-XWHK-2007712-Funaria	cysteine proteinase inhibitor A-like	93	20	3.35809E-47	72.88	IPR000010 (PFAM)
scaffold-ZTHV-2012897-Atrichum_angustatum	cysteine proteinase inhibitor A-like	70	20	1.83777E-28	78.26	IPR000010 (PFAM)
scaffold-TMAJ-2019725-Neckera_douglasii	cysteine proteinase inhibitor	90	20	1.11988E-46	72.98	IPR000010 (PFAM)
scaffold-VBMM-2007669-Anomodon_rostratus	cysteine proteinase inhibitor	88	20	6.23752E-46	72.28	IPR000010 (PFAM)
scaffold-EEMJ-2002315-Thuidium_delicatulum	cysteine proteinase inhibitor	90	20	8.39314E-43	73.64	IPR000010 (PFAM)
scaffold-EEMJ-2002317-Thuidium_delicatulum	cysteine proteinase inhibitor	90	20	8.39314E-43	73.64	IPR000010 (PFAM)
scaffold-JADL-2004394-Rhynchostegium_serrulatum	cysteine proteinase inhibitor	91	20	1.3728E-47	72.3	IPR000010 (PFAM)
scaffold-VMXJ-2122334-Leucobryum_albidum	cysteine proteinase inhibitor	90	20	1.69104E-43	73.57	IPR000010 (PFAM)
scaffold-LNSF-2007974-Hypnum_subimponens	cysteine proteinase inhibitor	90	20	5.30941E-47	72.42	IPR000010 (PFAM)
scaffold-HVBQ-2014846-Tetraphis_pellucida	cysteine proteinase inhibitor A-like	94	20	7.62362E-40	74.51	IPR000010 (PFAM)
scaffold-WSPM-2006582-Rhytidiadelphus_loreus	cysteine proteinase inhibitor	90	20	1.10766E-46	72.21	IPR000010 (PFAM)
scaffold-TAVP-2004418-Calliergon_cordifolium	cysteine proteinase inhibitor	90	20	9.73084E-46	70.81	IPR000010 (PFAM)
scaffold-VMXJ-2001609-Leucobryum_albidum	cysteine proteinase inhibitor A-like	83	20	1.86749E-41	76.76	IPR000010 (PFAM)
scaffold-VBMM-2007670-Anomodon_rostratus	cysteine proteinase inhibitor	90	20	1.48633E-47	72.32	IPR000010 (PFAM)
scaffold-DHWX-2010989-Fontinalis_antipyretica	cysteine proteinase inhibitor A-like	82	20	2.2604E-40	73.26	IPR000010 (PFAM)
scaffold-FFPD-2010143-Ceratodon_purpureus	cysteine proteinase inhibitor A-like	90	20	1.63272E-53	75.44	IPR000010 (PFAM)

scaffold-QMWB-2008408-Anomodon_attenuatus	cysteine proteinase inhibitor	90	20	4.31003E-47	72.21	IPR000010 (PFAM)
scaffold-QKQO-2008112-Pseudotaxiphyllum_elegans	cysteine proteinase inhibitor A-like	90	20	8.65957E-49	73.49	IPR000010 (PFAM)
scaffold-WSPM-2006581-Rhytidiadelphus_loreus	cysteine proteinase inhibitor	90	20	1.10766E-46	72.21	IPR000010 (PFAM)
scaffold-EEMJ-2002316-Thuidium_delicatulum	cysteine proteinase inhibitor	90	20	8.39314E-43	73.64	IPR000010 (PFAM)
scaffold-NGTD-2003215-Dicranum_scoparium	cysteine proteinase inhibitor A-like	80	20	3.30574E-44	78.35	IPR000010 (PFAM)
scaffold-LNSF-2007975-Hypnum_subimponens	cysteine proteinase inhibitor	90	20	5.30941E-47	72.42	IPR000010 (PFAM)
scaffold-FITN-2015102-Treubia_lacunose	cysteine proteinase inhibitor 10-like	93	4	2.74672E-13	63.45	IPR000010 (PFAM)
scaffold-GRKU-2010335-Syntrichia_princeps	cysteine proteinase inhibitor 3-like	70	20	1.27615E-37	73.99	IPR000010 (PFAM)
scaffold-GRKU-2010336-Syntrichia_princeps	cysteine proteinase inhibitor A-like	68	20	5.96443E-36	73.4	IPR000010 (PFAM)
scaffold-YEPO-2016840-cf._Physcomicromitrium_sp	cysteine proteinase inhibitor A-like	93	20	6.19977E-55	74.26	IPR000010 (PFAM)
scaffold-WZYK-2012484-Bazzania_trilobata	Cysteine proteinase inhibitor 6	55	20	3.44304E-16	75.69	IPR000010 (PFAM)

Apêndice 2C: Resultados gerados pelo programa Blast2GO das sequências de pteridófitas.

SeqName	Description	Length	#Hits	e-Value	sim mean	InterPro IDs
scaffold-NWWI-2027682-Nephrolepis_exaltata	cysteine proteinase inhibitor A-like	83	20	1.67718 E-25	71.78	IPR000010 (PFAM)
scaffold-NWWI-2027681-Nephrolepis_exaltata	cysteine proteinase inhibitor A-like	83	20	1.67718 E-25	71.78	IPR000010 (PFAM)
scaffold-NWWI-2128175-Nephrolepis_exaltata	cysteine proteinase inhibitor A-like	76	20	3.42458 E-23	74.66	IPR000010 (PFAM)
scaffold-NWWI-2027683-Nephrolepis_exaltata	cysteine proteinase inhibitor A-like	83	20	8.22973 E-26	71.49	IPR000010 (PFAM)
scaffold-NWWI-2128849-Nephrolepis_exaltata	cysteine proteinase inhibitor A-like	75	20	2.80354 E-25	77.53	IPR000010 (PFAM)
scaffold-QVMR-2000756-Psilotum_nudum	cysteine proteinase inhibitor-like	89	20	1.04105 E-28	75.16	IPR000010 (PFAM)
scaffold-UXCS-2009844-Marattia_sp	cysteine proteinase inhibitor	91	20	4.06163 E-27	71.9	IPR000010 (PFAM)
scaffold-UXCS-2009845-Marattia_sp	cysteine proteinase inhibitor	91	20	4.06163 E-27	71.9	IPR000010 (PFAM)
scaffold-UGNK-2019349-Marattia_attenuata	cysteine proteinase inhibitor	91	20	8.72356 E-27	71.61	IPR000010 (PFAM)
scaffold-YLJA-2067337-Polypodium_amorphum	cysteine proteinase inhibitor-like	92	20	1.87774 E-24	72.43	IPR000010 (PFAM)
scaffold-ENQF-2001416-Lycopodium_annotinum	cysteine proteinase inhibitor	87	20	4.30352 E-30	75.31	IPR000010 (PFAM)
scaffold-XNXF-2009321-Dendrolycopodium_obscurum	cysteine proteinase inhibitor	92	20	1.55798 E-33	76.59	IPR000010 (PFAM)
scaffold-XNXF-2009319-Dendrolycopodium_obscurum	cysteine proteinase inhibitor	92	20	1.55798 E-33	76.59	IPR000010 (PFAM)
scaffold-UPMJ-2000244-Pseudolycopodiella_caroliniana	cysteine proteinase inhibitor	92	20	2.19278 E-32	73.84	IPR000010 (PFAM)
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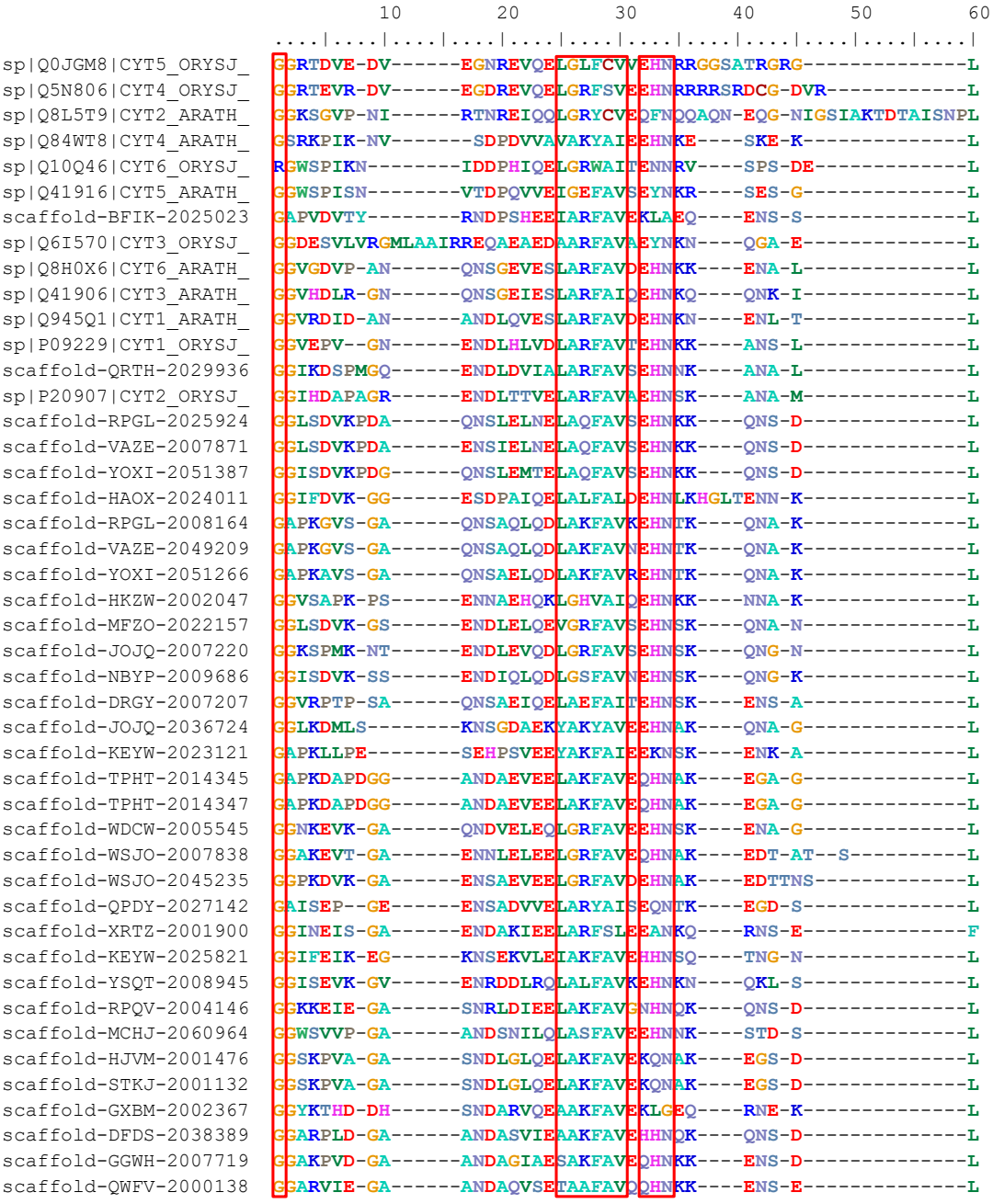
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scaffold-JVSZ-2124731-Equisetum_hymale	cysteine protease inhibitor	89	20	5.47357E-28	77.25	IPR000010 (PFAM)
scaffold-LGDQ-2002821-Selaginella_apoda	cysteine proteinase inhibitor	91	20	1.01084E-46	77.61	IPR000010 (PFAM)
scaffold-YJJY-2074696-Woodsia_scopulina	cysteine proteinase inhibitor A-like	90	20	1.66389E-29	71.28	IPR000010 (PFAM)
scaffold-CAPN-2038518-Equisetum_diffusum	cysteine proteinase inhibitor 6-like	89	20	3.86426E-28	79.17	IPR000010 (PFAM)
scaffold-WCLG-2062418-Adiantum_aleuticum	cysteine proteinase inhibitor A-like	88	20	3.80736E-28	71.76	IPR000010 (PFAM)
scaffold-WCLG-2063060-Adiantum_aleuticum	cysteine proteinase inhibitor A-like	77	20	4.27944E-29	81.75	IPR000010 (PFAM)
scaffold-YOWV-2011965-Cystopteris_protrusa	cysteine proteinase inhibitor A-like	76	20	6.93938E-26	77.17	IPR000010 (PFAM)
scaffold-ZQYU-2024887-Polypodium_plectolens	cysteine proteinase inhibitor A-like	88	20	3.60442E-28	70.72	IPR000010 (PFAM)
scaffold-ZQYU-2024886-Polypodium_plectolens	cysteine proteinase inhibitor A-like	88	20	3.60442E-28	70.72	IPR000010 (PFAM)
scaffold-WQML-2065582-Cryptogramma_acrostichoides	cysteine proteinase inhibitor A-like	88	20	7.28038E-29	70.92	IPR000010 (PFAM)
scaffold-XXHP-2085502-Cystopteris_fragilis-Stewart	cysteine proteinase inhibitor A-like	76	20	6.28703E-26	77.24	IPR000010 (PFAM)
scaffold-GTUO-2007468-Huperzia_selago	cysteine proteinase inhibitor-like	91	20	2.5906E-25	68.23	IPR000010 (PFAM)
scaffold-NYBX-2016528-Huperzia_selago-A	cysteine proteinase inhibitor-like	91	20	2.5906E-25	68.23	IPR000010 (PFAM)
scaffold-BEGM-2014655-Botrypus_virginianus	cysteine proteinase inhibitor A-like	89	20	1.27192E-30	77.82	IPR000010 (PFAM)
scaffold-WTJG-2006950-Ophioglossum_vulgatum	cysteine proteinase inhibitor	96	20	1.01121E-30	74.02	IPR000010 (PFAM)
scaffold-YIXP-2048843-Lindsaea_microphylla	cysteine proteinase inhibitor A-like	93	20	3.80829E-22	70.51	IPR000010 (PFAM)
scaffold-ENQF-2083393-Lycopodium_annotinum	cysteine protease inhibitor	90	20	4.42793E-27	73.62	IPR000010 (PFAM)
scaffold-WGTU-2069007-Leucostegia_immersa	cysteine proteinase inhibitor A-like	77	20	3.98761E-28	77.08	IPR000010 (PFAM)
scaffold-YJJY-2074148-Woodsia_scopulina	cysteine proteinase inhibitor A-like	76	20	2.35697E-27	79.36	IPR000010 (PFAM)
scaffold-VVRN-2096727-Lonchitis_hirsuta	cysteine proteinase inhibitor	88	20	4.36887E-26	70.16	IPR000010 (PFAM)
scaffold-XNXF-2012591-Dendrolycopodium_obscurum	cysteine protease inhibitor	89	20	1.0824E-27	74.82	IPR000010 (PFAM)
scaffold-GKAG-2007937-Huperzia_lucidula	cysteine proteinase inhibitor-like	91	20	2.5906E-25	68.23	IPR000010 (PFAM)
scaffold-YIXP-2053845-Lindsaea_microphylla	cysteine proteinase inhibitor A-like	85	20	8.74208E-27	68.94	IPR000010 (PFAM)
scaffold-YLJA-2070316-Polypodium_amorphum	cysteine proteinase inhibitor A-like	91	20	3.18315E-27	70.89	IPR000010 (PFAM)
scaffold-LGDQ-2002822-Selaginella_apoda	cysteine proteinase inhibitor	91	20	1.01084E-46	77.61	IPR000010 (PFAM)
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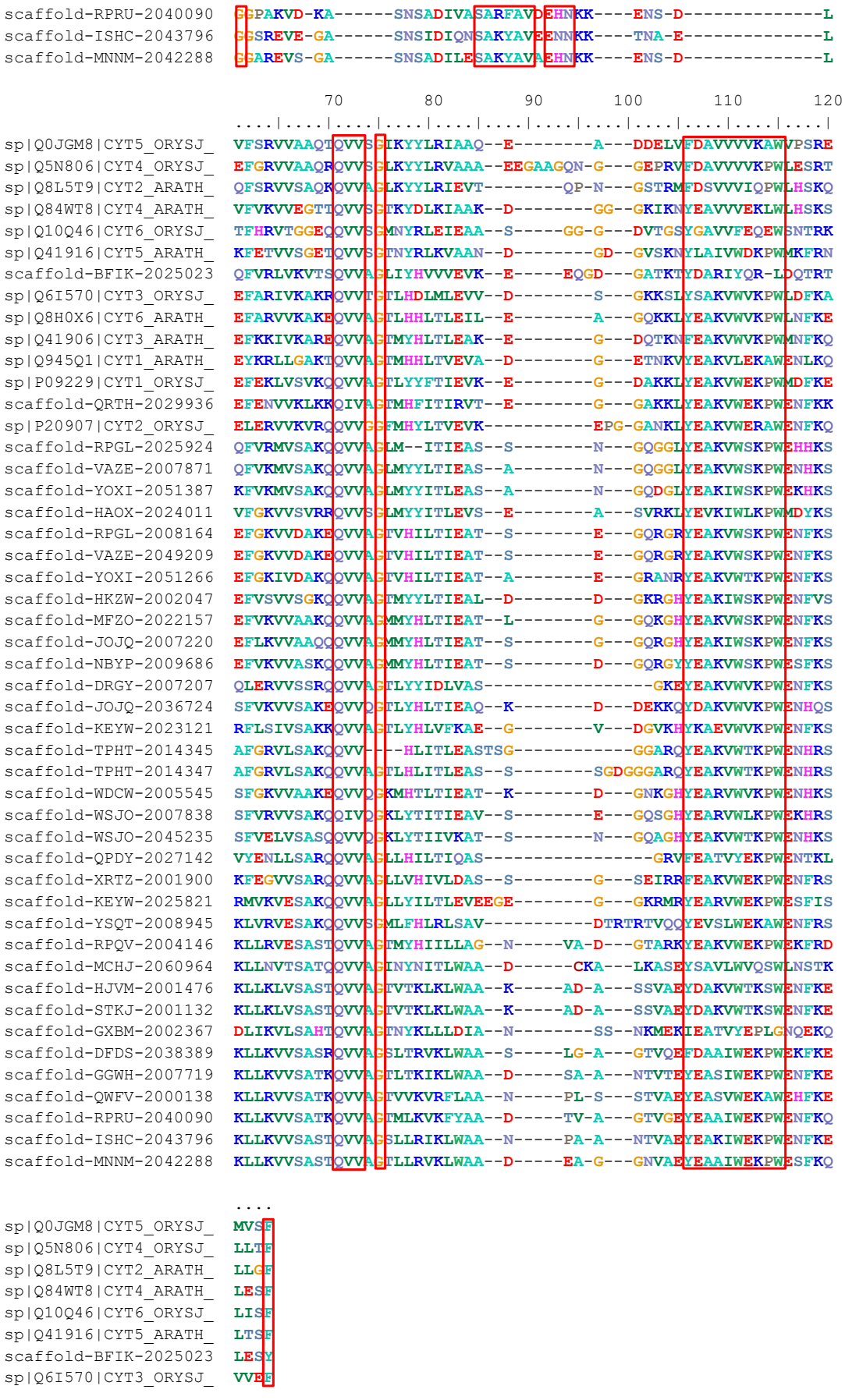
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scaffold-UXCS-2123341-Marattia_sp	cysteine proteinase inhibitor	93	20	1.47535E-22	74.36	IPR000010 (PFAM)
scaffold-YQEC-2005416-Woodsia_ilvensis	cysteine proteinase inhibitor A-like	89	20	3.5647E-27	73.93	IPR000010 (PFAM)
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scaffold-GKAG-2007938-Huperzia_lucidula	cysteine proteinase inhibitor-like	91	20	2.5906E-25	68.23	IPR000010 (PFAM)
scaffold-GKAG-2007934-Huperzia_lucidula	cysteine proteinase inhibitor-like	91	20	2.5906E-25	68.23	IPR000010 (PFAM)
scaffold-ALVQ-2015531-Tmesipteris_parva	cysteine proteinase inhibitor A-like	90	20	2.74871E-25	73.06	IPR000010 (PFAM)
scaffold-YLJA-2070379-Polypodium_amorphum	cysteine proteinase inhibitor	86	20	3.03608E-26	71.73	IPR000010 (PFAM)
scaffold-KUXM-2002014-Selaginella_selaginoides	cysteine proteinase inhibitor-like	80	20	2.59692E-28	80.39	IPR000010 (PFAM)
scaffold-DFHO-2051919-Danaea_nodosa	cysteine proteinase inhibitor 6	85	20	2.49465E-24	74.12	IPR000010 (PFAM)
scaffold-YQEC-2073340-Woodsia_ilvensis	cysteine proteinase inhibitor A-like	85	20	7.0221E-27	71.39	IPR000010 (PFAM)
scaffold-WGTU-2065783-Leucostegia_immersa	cysteine proteinase inhibitor	88	20	5.19664E-22	68.02	IPR000010 (PFAM)
scaffold-WGTU-2071101-Leucostegia_immersa	cysteine proteinase inhibitor A-like	88	20	2.28959E-26	71.02	IPR000010 (PFAM)
scaffold-WAFT-2008471-Diphasiastrum_digitatum	cysteine proteinase inhibitor A-like	90	20	2.83058E-27	74.15	IPR000010 (PFAM)
scaffold-UPMJ-2013761-Pseudolycopodiella_caroliniana	cysteine proteinase inhibitor A-like	89	20	4.13769E-27	73.31	IPR000010 (PFAM)
scaffold-ZXJO-2012080-Hemionitis_arifolia	cysteine proteinase inhibitor A-like	85	20	1.60416E-26	70.18	IPR000010 (PFAM)
scaffold-GAON-2056883-Huperzia_squarrosa	cysteine proteinase inhibitor A-like	87	20	9.40659E-26	71.61	IPR000010 (PFAM)
scaffold-WQML-2064208-Cryptogramma_acrostichoides	cysteine proteinase inhibitor	88	20	4.01308E-27	76.38	IPR000010 (PFAM)
scaffold-PYHZ-2006184-Isoetes_sp	Cysteine proteinase inhibitor 6 like	91	20	2.33443E-26	71.43	IPR000010 (PFAM)
scaffold-JVSZ-2123331-Equisetum_hymale	cysteine proteinase inhibitor A-like	90	20	4.9144E-27	74.79	IPR000010 (PFAM)
scaffold-CAPN-2038044-Equisetum_diffusum	cysteine proteinase inhibitor	94	20	3.99799E-21	70.59	IPR000010 (PFAM)
scaffold-WAFT-2064863-Diphasiastrum_digitatum	cysteine proteinase inhibitor	81	20	1.26441E-27	74.44	IPR000010 (PFAM)
scaffold-GKAG-2007936-Huperzia_lucidula	cysteine proteinase inhibitor-like	88	20	2.82189E-26	70.17	IPR000010 (PFAM)
scaffold-ALVQ-2102338-Tmesipteris_parva	cysteine proteinase inhibitor A-like	89	20	2.53627E-30	76.09	IPR000010 (PFAM)
scaffold-PKOX-2005783-Isoetes_tegetiformans	Cysteine proteinase inhibitor 6 like	91	20	2.80344E-26	71.71	IPR000010 (PFAM)
scaffold-PKOX-2005782-Isoetes_tegetiformans	Cysteine proteinase inhibitor 6 like	91	20	2.80344E-26	71.71	IPR000010 (PFAM)
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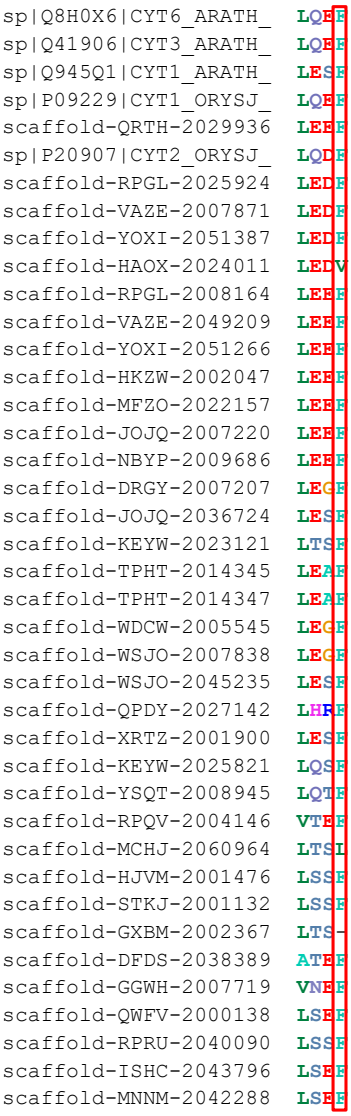
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scaffold-GTUO-2012232-Huperzia_selago	cysteine proteinase inhibitor-like	91	20	2.55472E-26	70.85	IPR000010 (PFAM)
scaffold-XXHP-2086686-Cystopteris_fragilis-Stewart	cysteine proteinase inhibitor A-like	85	20	5.50545E-26	70.44	IPR000010 (PFAM)
scaffold-YOWV-2005477-Cystopteris_protrusa	cysteine proteinase inhibitor A-like	85	20	5.50545E-26	70.44	IPR000010 (PFAM)
scaffold-PYHZ-2006185-Isoetes_sp	Cysteine proteinase inhibitor 6 like	91	20	2.33443E-26	71.43	IPR000010 (PFAM)
scaffold-YIXP-2006600-Lindsaea_microphylla	cysteine proteinase inhibitor A-like	87	20	1.3618E-24	75.9	IPR000010 (PFAM)
scaffold-YLJA-2065650-Polypodium_amorphum	cysteine proteinase inhibitor A-like	93	20	8.51203E-23	68.46	IPR000010 (PFAM)
scaffold-JVSZ-2126856-Equisetum_hymale	cysteine proteinase inhibitor-like	82	20	6.21007E-21	73.91	IPR000010 (PFAM)
scaffold-YCKE-2056722-Notholaena_montieliae	cysteine proteinase inhibitor A-like	88	20	1.87813E-24	71.8	IPR000010 (PFAM)
scaffold-YJJY-2011111-Woodsia_scopulina	cysteine proteinase inhibitor A-like	89	20	2.05495E-22	68.65	IPR000010 (PFAM)
scaffold-YQEC-2066571-Woodsia_ilvensis	cysteine proteinase inhibitor A-like	91	20	2.9299E-22	69.86	IPR000010 (PFAM)
scaffold-ULKT-2002262-Lycopodiella_apressa	cysteine proteinase inhibitor A-like	91	20	5.62571E-27	71.81	IPR000010 (PFAM)
scaffold-XXHP-2081833-Cystopteris_fragilis-Stewart	cysteine proteinase inhibitor A-like	90	20	1.81012E-22	68.57	IPR000010 (PFAM)
scaffold-YOWV-2059692-Cystopteris_protrusa	cysteine proteinase inhibitor A-like	90	20	1.81012E-22	68.57	IPR000010 (PFAM)
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scaffold-QVMR-2055518-Psilotum_nudum	cysteine proteinase inhibitor-like	75	20	1.49784E-26	77.83	IPR000010 (PFAM)
scaffold-ZQYU-2109890-Polypodium_plectolens	cysteine proteinase inhibitor A-like	93	20	2.59918E-22	67.92	IPR000010 (PFAM)
scaffold-CBAE-2012176-Huperzia_myrisinites	cysteine proteinase inhibitor A-like	88	20	5.70571E-24	70.43	IPR000010 (PFAM)
scaffold-QHVS-2101137-Ophioglossum_vulgatum-leaf	cysteine proteinase inhibitor-like	91	20	3.27675E-21	71.7	IPR000010 (PFAM)
scaffold-WQML-2060211-Cryptogramma_acrostichoides	cysteine proteinase inhibitor 6-like	85	20	1.93739E-24	71.22	IPR000010 (PFAM)
scaffold-ULKT-2008193-Lycopodiella_apressa	cysteine proteinase inhibitor A-like	88	20	5.64168E-23	68.51	IPR000010 (PFAM)
scaffold-XXHP-2084905-Cystopteris_fragilis-Stewart	cysteine proteinase inhibitor A-like	71	20	4.65959E-22	75.96	IPR000010 (PFAM)
scaffold-JVSZ-2126207-Equisetum_hymale	cysteine proteinase inhibitor A-like	87	20	4.72049E-21	70.59	IPR000010 (PFAM)
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scaffold-UPMJ-2081031-Pseudolycopodiella_caroliniana	cysteine proteinase inhibitor A-like	77	20	4.62267E-23	74.16	IPR000010 (PFAM)
scaffold-NYBX-2012715-Huperzia_selago-A	cysteine proteinase inhibitor A-like	77	20	2.48869E-25	73.35	IPR000010 (PFAM)
scaffold-PQTO-2080101-Lycopodium_deuterodensum	cysteine proteinase inhibitor A-like	77	20	7.53546E-22	73.46	IPR000010 (PFAM)

scaffold-ZXJO-2070042-Hemionitis_arifolia	cysteine protease inhibitor	73	20	2.32025 E-22	75.47	IPR000010 (PFAM)
scaffold-PKOX-2093010-Isoetes_tegetiformans	---NA---	78				IPR000010 (PFAM)
scaffold-ZXJO-2014140-Hemionitis_arifolia	cysteine proteinase inhibitor A-like	87	20	4.92808 E-22	69.72	IPR000010 (PFAM)
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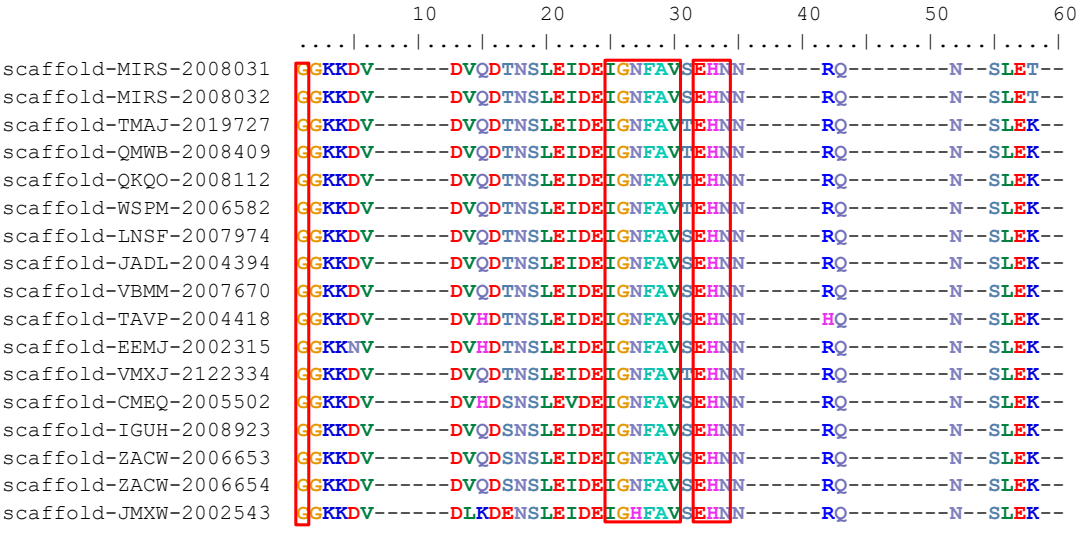
Apêndice 3A. Alinhamento das sequências identificadas em algas verdes. As regiões destacadas são importantes para fitocistatinas.

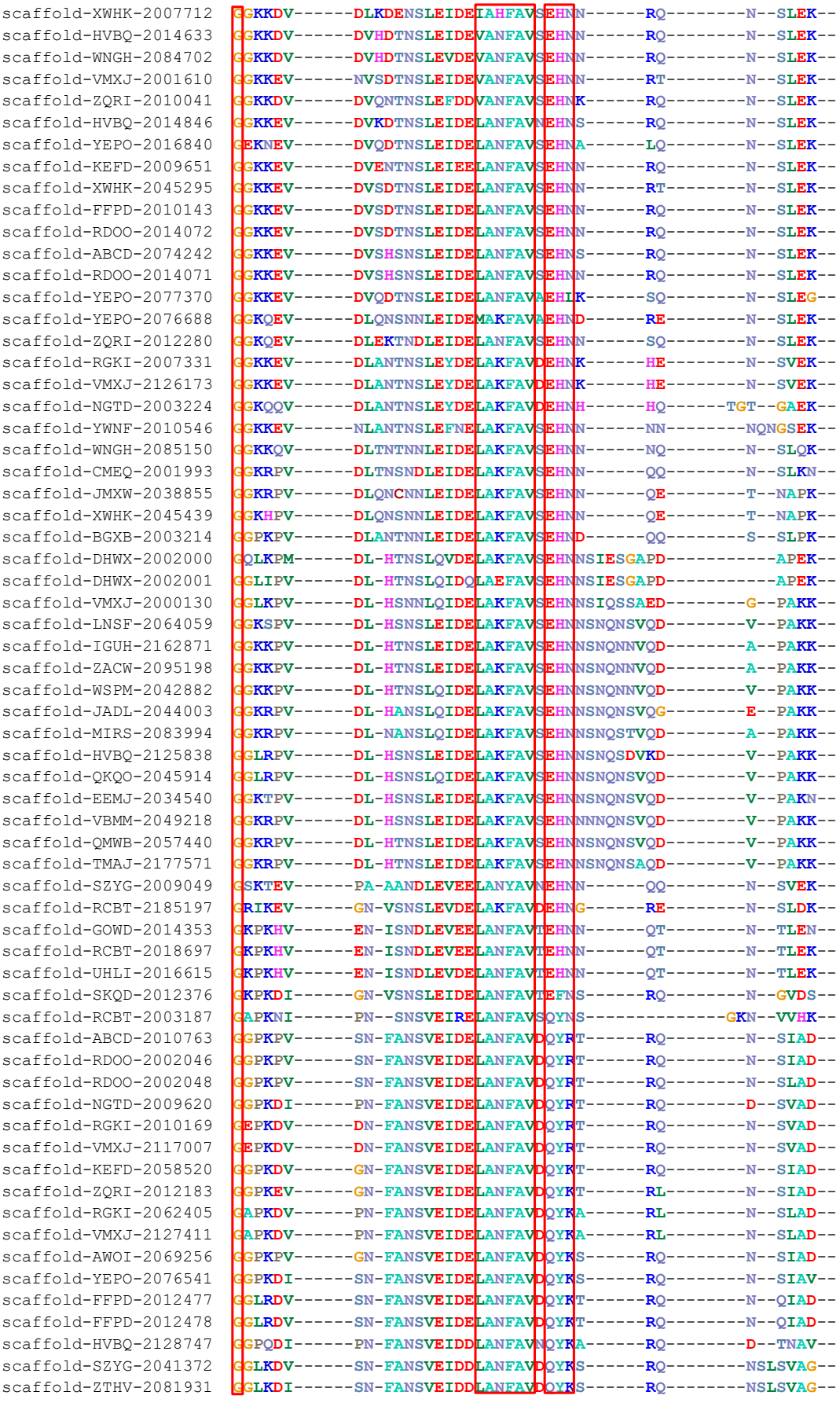


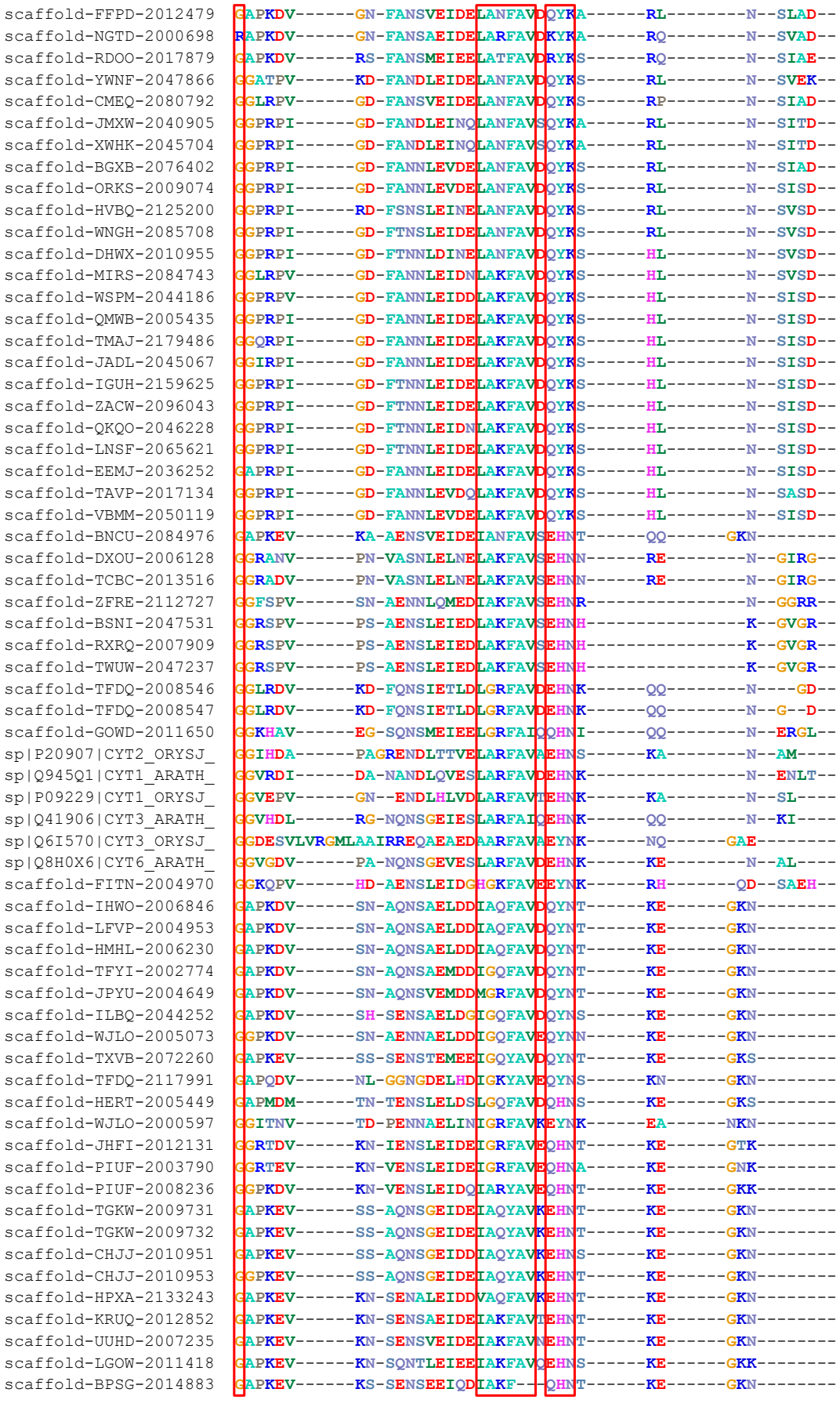

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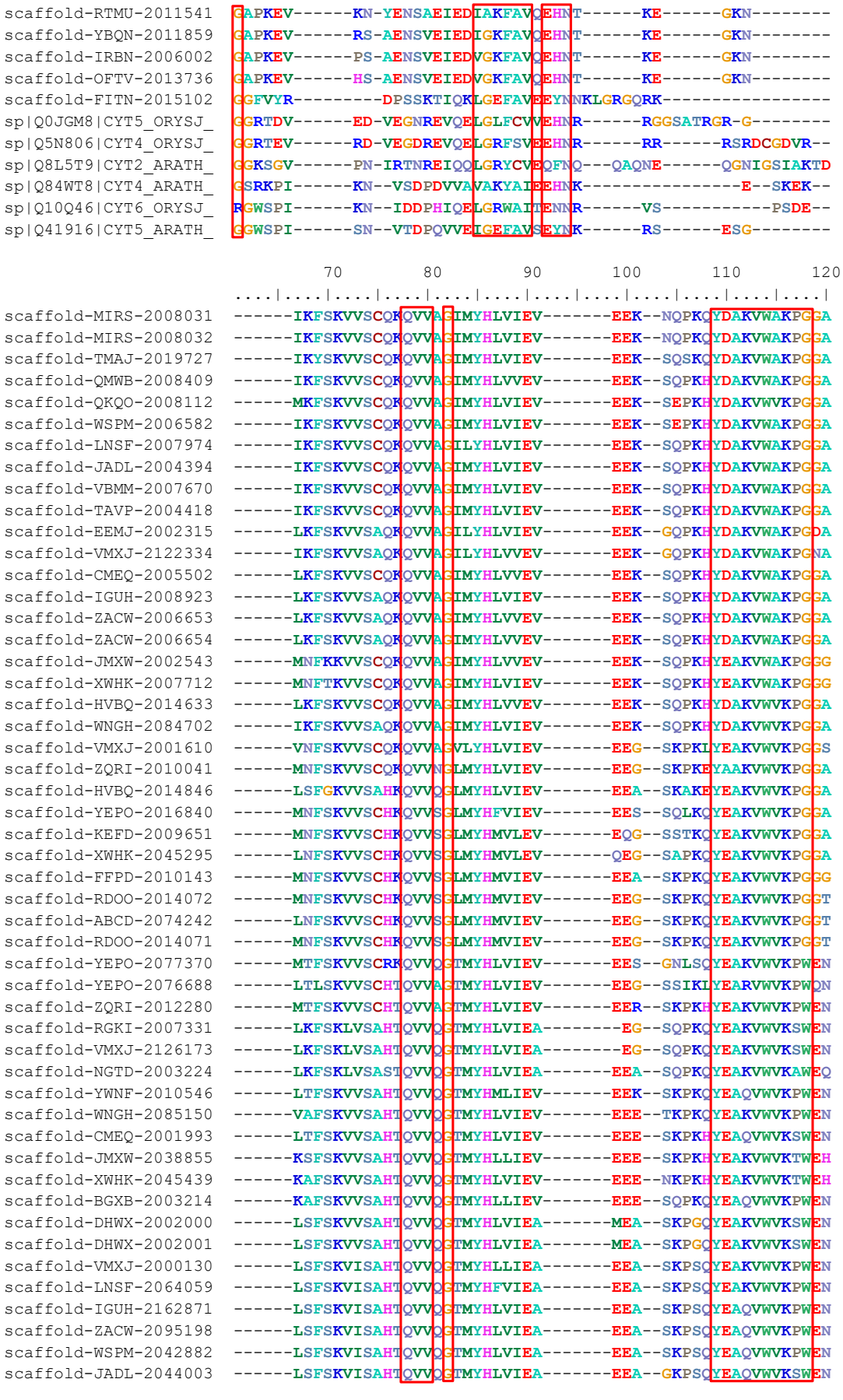


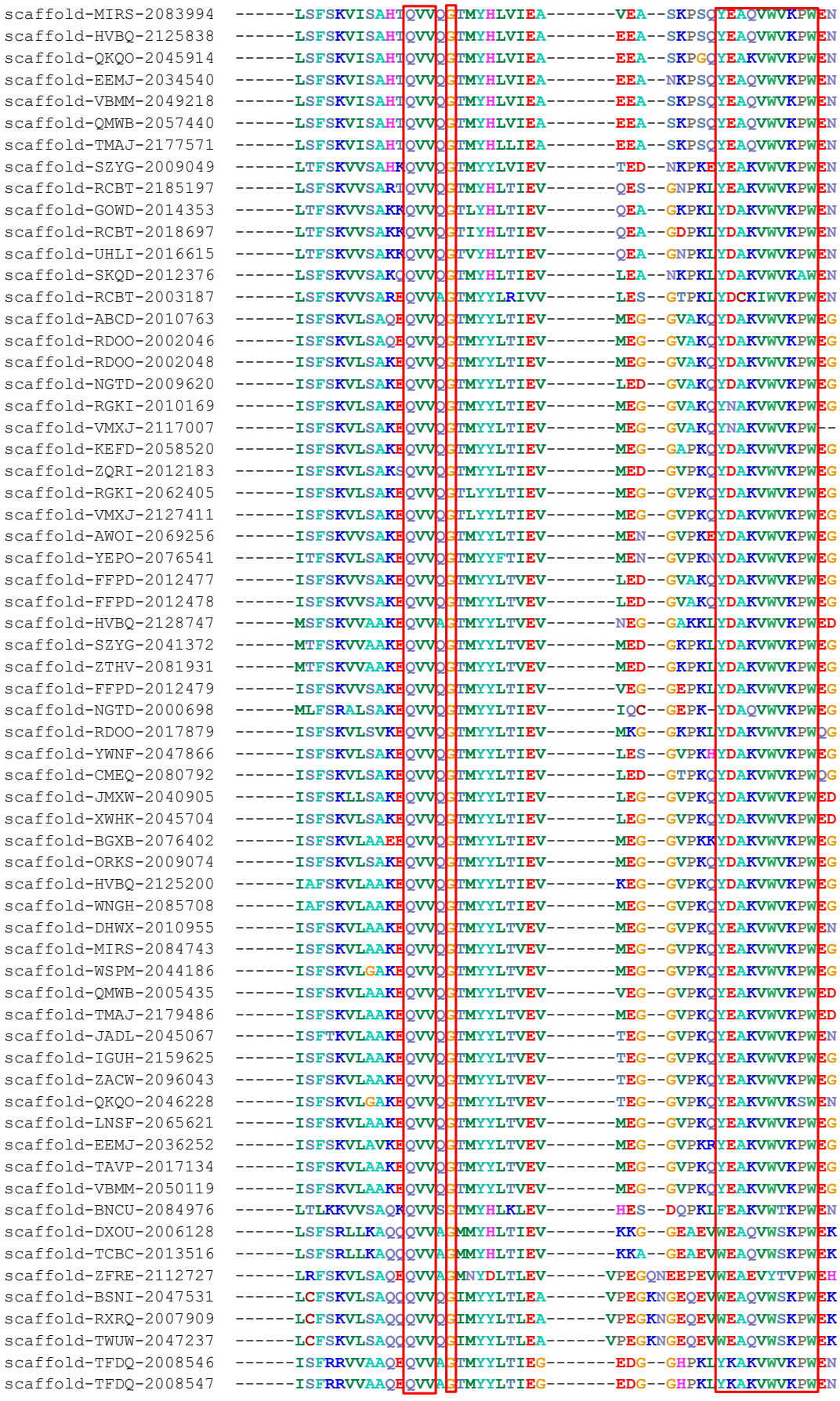
Apêndice 3B. Alinhamento das sequências identificadas em briófitas. As regiões destacadas são importantes para fitocistatinas.

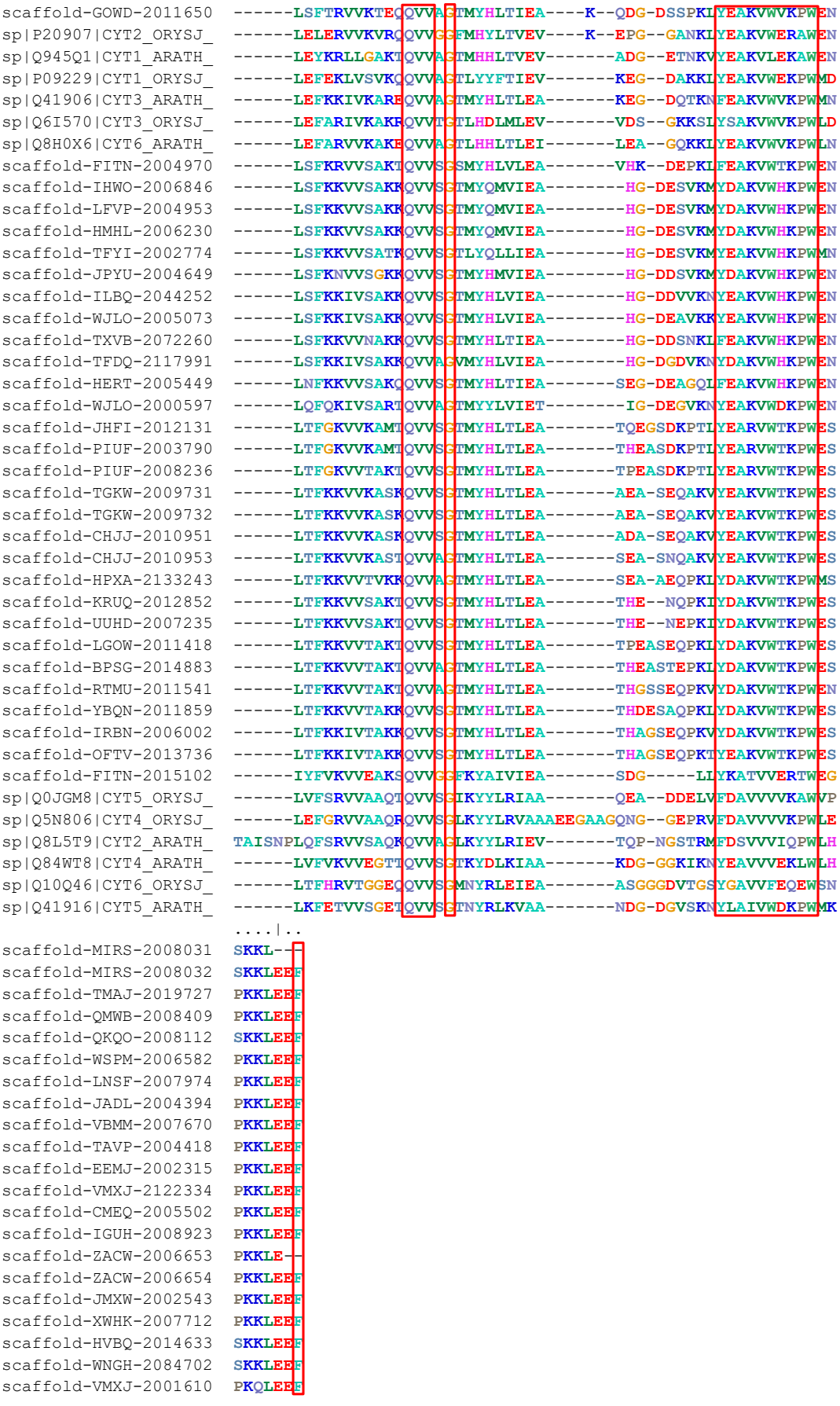



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scaffold-HVBQ-2014846 GGKKEV------DVKDTNSLEIDELANFAVNEHNS------RQ--------N--SLEK--
scaffold-YEPO-2016840 GEKNEV------DVQDTNSLEIDELANFAVSEHNA------LQ--------N--SLEK--
scaffold-KEFD-2009651 GGKKEV------DVENTNSLEIEELANFAVSEHNN------RQ--------N--SLEK--
scaffold-XWHK-2045295 GGKKEV------DVSDTNSLEIDELANFAVSEHNN------RT--------N--SLEK--
scaffold-FFPD-2010143 GGKKEV------DVSDTNSLEIDELANFAVSEHNN------RQ--------N--SLEK--
scaffold-RDOO-2014072 GGKKEV------DVSDTNSLEIDELANFAVSEHNN------RQ--------N--SLEK--
scaffold-ABCD-2074242 GGKKEV------DVSHSNSLEIDELANFAVSEHNS------RQ--------N--SLEK--
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scaffold-YEPO-2077370 GGKKEV------DVQDTNSLEIDELANFAVAEHIK------SQ--------N--SLEG--
scaffold-YEPO-2076688 GGKQEV------DLQNSNNLEIDEMAKFAVAEHND------RE--------N--SLEK--
scaffold-ZQRI-2012280 GGKQEV------DLEKTNDLEIDELANFAVSEHNN------SQ--------N--SLEK--
scaffold-RGKI-2007331 GGKKEV------DLANTNSLEYDELAKFAVDEHNK------HE--------N--SVEK--
scaffold-VMXJ-2126173 GGKKEV------DLANTNSLEYDELAKFAVDEHNK------HE--------N--SVEK--
scaffold-NGTD-2003224 GGKQQV------DLANTNSLEYDELAKFAVDEHNH------HQ------TGT--GAEK--
scaffold-YWNF-2010546 GGKKEV------NLANTNSLEFNELAKFAVSEHNN------NN--------NQNGSEK--
scaffold-WNGH-2085150 GGKKQV------DLTNTNNLEIDELAKFAVSEHNN------NQ--------N--SLQK--
scaffold-CMEQ-2001993 GGKRPV------DLTNSNDLEIDELAKFAVSEHNN------QQ--------N--SLKN--
scaffold-JMXW-2038855 GGKRPV------DLQNCNNLEIDELAKFAVSEHNN------QE--------T--NAPK--
scaffold-XWHK-2045439 GGKHPV------DLQNSNNLEIDELAKFAVSEHNN------QE--------T--NAPK--
scaffold-BGXB-2003214 GGPKPV------DLANTNNLEIDELAKFAVSEHND------QQ--------S--SLPK--
scaffold-DHWX-2002000 GQLKPM------DL-HTNSLQVDELAKFAVSEHNNSIESGAPD----------APEK--
scaffold-DHWX-2002001 GGLIPV------DL-HTNSLQIDQLAEFAVSEHNNSIESGAPD----------APEK--
scaffold-VMXJ-2000130 GGLKPV------DL-HSNNLQIDELAKFAVSEHNNSIQSSAED--------G--PAKK--
scaffold-LNSF-2064059 GGKSPV------DL-HSNSLEIDELAKFAVSEHNNSNQNSVQD--------V--PAKK--
scaffold-IGUH-2162871 GGKKPV------DL-HTNSLEIDELAKFAVSEHNNSNQNNVQD--------A--PAKK--
scaffold-ZACW-2095198 GGKKPV------DL-HTNSLEIDELAKFAVSEHNNSNQNNVQD--------A--PAKK--
scaffold-WSPM-2042882 GGKKPV------DL-HTNSLQIDELAKFAVSEHNNSNQNNVQD--------V--PAKK--
scaffold-JADL-2044003 GGKRPV------DL-HANSLQIDELAKFAVSEHNNSNQNSVQG--------E--PAKK--
scaffold-MIRS-2083994 GGKRPV------DL-NANSLQIDELAKFAVSEHNNSNQSTVQD--------A--PAKK--
scaffold-HVBQ-2125838 GGLRPV------DL-HSNSLEIDELAKFAVSEHNNSNQSDVKD--------V--PAKK--
scaffold-QKQO-2045914 GGLRPV------DL-HSNSLQIDELAKFAVSEHNNSNQNSVQD--------V--PAKK--
scaffold-EEMJ-2034540 GGKTPV------DL-HSNSLEIDELAKFAVSEHNNSNQNSVQD--------V--PAKN--
scaffold-VBMM-2049218 GGKRPV------DL-HSNSLEIDELAKFAVSEHNNNNQNSVQD--------V--PAKK--
scaffold-QMWB-2057440 GGKRPV------DL-HTNSLEIDELAKFAVSEHNNSNQNSVQD--------V--PAKK--
scaffold-TMAJ-2177571 GGKRPV------DL-HTNSLEIDELAKFAVSEHNNSNQNSAQD--------V--PAKK--
scaffold-SZYG-2009049 GSKTEV------PA-AANDLEVEELANYAVNEHNN------QQ--------N--SVEK--
scaffold-RCBT-2185197 GRIKEV------GN-VSNSLEVDELAKFAVDEHNG------RE--------N--SLDK--
scaffold-GOWD-2014353 GKPKHV------EN-ISNDLEVEELANFAVTEHNN------QT--------N--TLEN--
scaffold-RCBT-2018697 GKPKHV------EN-ISNDLEVEELANFAVTEHNN------QT--------N--TLEK--
scaffold-UHLI-2016615 GKPKHV------EN-ISNDLEVDELANFAVTEHNN------QT--------N--TLEK--
scaffold-SKQD-2012376 GKPKDI------GN-VSNSLEIDELANFAVTEFNS------RQ--------N--GVDS--
scaffold-RCBT-2003187 GAPKNI------PN--SNSVEIRELANFAVSQYNS--------------GKN--VVHK--
scaffold-ABCD-2010763 GGPKPV------SN-FANSVEIDELANFAVDQYRT------RQ--------N--SIAD--
scaffold-RDOO-2002046 GGPKPV------SN-FANSVEIDELANFAVDQYRT------RQ--------N--SIAD--
scaffold-RDOO-2002048 GGPKPV------SN-FANSVEIDELANFAVDQYRT------RQ--------N--SLAD--
scaffold-NGTD-2009620 GGPKDI------PN-FANSVEIDELANFAVDQYRT------RQ--------D--SVAD--
scaffold-RGKI-2010169 GEPKDV------DN-FANSVEIDELANFAVDQYRT------RQ--------N--SVAD--
scaffold-VMXJ-2117007 GEPKDV------DN-FANSVEIDELANFAVDQYRT------RQ--------N--SVAD--
scaffold-KEFD-2058520 GGPKDV------GN-FANSVEIDELANFAVDQYKT------RQ--------N--SIAD--
scaffold-ZQRI-2012183 GGPKEV------GN-FANSVEIDELANFAVDQYKT------RL--------N--SIAD--
scaffold-RGKI-2062405 GAPKDV------PN-FANSVEIDELANFAVDQYKA------RL--------N--SLAD--
scaffold-VMXJ-2127411 GAPKDV------PN-FANSVEIDELANFAVDQYKA------RL--------N--SLAD--
scaffold-AWOI-2069256 GGPKPV------GN-FANSVEIDELANFAVDQYKS------RQ--------N--SIAD--
scaffold-YEPO-2076541 GGPKDI------SN-FANSVEIDELANFAVDQYKS------RQ--------N--SIAV--
scaffold-FFPD-2012477 GGLRDV------SN-FANSVEIDELANFAVDQYKT------RQ--------N--QIAD--
scaffold-FFPD-2012478 GGLRDV------SN-FANSVEIDELANFAVDQYKT------RQ--------N--QIAD--
scaffold-HVBQ-2128747 GGPQDI------PN-FANSVEIDDLANFAVNQYKA------RQ--------D--TNAV--
scaffold-SZYG-2041372 GGLKDV------SN-FANSVEIDDLANFAVDQYKS------RQ--------NSLSVAG--
scaffold-ZTHV-2081931 GGLKDI------SN-FANSVEIDDLANFAVDQYKS------RQ--------NSLSVAG--


scaffold-FFPD-2012479 GAPKDV------GN-FANSVEIDELANFAVDQYKA------RL--------N--SLAD--
scaffold-NGTD-2000698 RAPKDV------GN-FANSAEIDELARFAVDKYKA------RQ--------N--SVAD--
scaffold-RDOO-2017879 GAPKDV------RS-FANSMEIEELATFAVDRYKS------RQ--------N--SIAE--
scaffold-YWNF-2047866 GGATPV------KD-FANDLEIDELANFAVDQYKS------RL--------N--SVEK--
scaffold-CMEQ-2080792 GGLRPV------GD-FANSVEIDELANFAVDQYKS------RP--------N--SIAD--
scaffold-JMXW-2040905 GGPRPI------GD-FANDLEINQLANFAVSQYKA------RL--------N--SITD--
scaffold-XWHK-2045704 GGPRPI------GD-FANDLEINQLANFAVSQYKA------RL--------N--SITD--
scaffold-BGXB-2076402 GGPRPI------GD-FANNLEVDELANFAVDQYKS------RL--------N--SIAD--
scaffold-ORKS-2009074 GGPRPI------GD-FANNLEVDELANFAVDQYKS------RL--------N--SISD--
scaffold-HVBQ-2125200 GGPRPI------RD-FSNSLEINELANFAVDQYKS------RL--------N--SVSD--
scaffold-WNGH-2085708 GGPRPI------GD-FTNSLEIDELANFAVDQYKS------RL--------N--SVSD--
scaffold-DHWX-2010955 GGPRPI------GD-FTNNLDINELANFAVDQYKS------HL--------N--SVSD--
scaffold-MIRS-2084743 GGLRPV------GD-FANNLEIDNLAKFAVDQYKS------HL--------N--SVSD--
scaffold-WSPM-2044186 GGPRPV------GD-FANNLEIDDLAKFAVDQYKS------HL--------N--SISD--
scaffold-QMWB-2005435 GGPRPI------GD-FANNLEIDELAKFAVDQYKS------HL--------N--SISD--
scaffold-TMAJ-2179486 GGQRPI------GD-FANNLEIDELAKFAVDQYKS------HL--------N--SISD--
scaffold-JADL-2045067 GGIRPI------GD-FANNLEIDELAKFAVDQYKS------HL--------N--SISD--
scaffold-IGUH-2159625 GGPRPI------GD-FTNNLEIDELAKFAVDQYKS------HL--------N--SISD--
scaffold-ZACW-2096043 GGPRPI------GD-FTNNLEIDELAKFAVDQYKS------HL--------N--SISD--
scaffold-QKQO-2046228 GGPRPI------GD-FTNNLEIDNLAKFAVDQYKS------HL--------N--SISD--
scaffold-LNSF-2065621 GGPRPI------GD-FTNNLEIDELAKFAVDQYKS------HL--------N--SISD--
scaffold-EEMJ-2036252 GAPRPI------GD-FANNLEIDELAKFAVDQYKS------HL--------N--SISD--
scaffold-TAVP-2017134 GGPRPI------GD-FANNLEVDQLAKFAVDQYKS------HL--------N--SASD--
scaffold-VBMM-2050119 GGPRPI------GD-FANNLEVDELAKFAVDQYKS------HL--------N--SISD--
scaffold-BNCU-2084976 GAPKEV------KA-AENSVEIDEIANFAVSEHNT------QQ------GKN---------
scaffold-DXOU-2006128 GGRANV------PN-VASNLELNELAKFAVSEHNN------RE--------N--GIRG--
scaffold-TCBC-2013516 GGRADV------PN-VASNLELNELAKFAVSEHNN------RE--------N--GIRG--
scaffold-ZFRE-2112727 GGFSPV------SN-AENNLQMEDIAKFAVSEHNR----------------N--GGRR--
scaffold-BSNI-2047531 GGRSPV------PS-AENSLEIEDLAKFAVSEHNH----------------K--GVGR--
scaffold-RXRQ-2007909 GGRSPV------PS-AENSLEIEDLAKFAVSEHNH----------------K--GVGR--
scaffold-TWUW-2047237 GGRSPV------PS-AENSLEIEDLAKFAVSEHNH----------------K--GVGR--
scaffold-TFDQ-2008546 GGLRDV------KD-FQNSIETLDLGRFAVDEHNK------QQ--------N----GD--
scaffold-TFDQ-2008547 GGLRDV------KD-FQNSIETLDLGRFAVDEHNK------QQ--------N--G--D--
scaffold-GOWD-2011650 GGKHAV------EG-SQNSMEIEELGRFAIQQHNI------QQ--------N--ERGL--
sp|P20907|CYT2_ORYSJ_ GGIHDA------PAGRENDLTTVELARFAVAEHNS------KA--------N--AM----
sp|Q945Q1|CYT1_ARATH_ GGVRDI------DA-NANDLQVESLARFAVDEHNK----------------N--ENLT--
sp|P09229|CYT1_ORYSJ_ GGVEPV------GN--ENDLHLVDLARFAVTEHNK------KA--------N--SL----
sp|Q41906|CYT3_ARATH_ GGVHDL------RG-NQNSGEIESLARFAIQEHNK------QQ--------N--KI----
sp|Q6I570|CYT3_ORYSJ_ GGDESVLVRGMLAAIRREQAEAEDAARFAVAEYNK------NQ------GAE---------
sp|Q8H0X6|CYT6_ARATH_ GGVGDV------PA-NQNSGEVESLARFAVDEHNK------KE--------N--AL----
scaffold-FITN-2004970 GGKQPV------HD-AENSLEIDGHGKFAVEEYNK------RH-------QD--SAEH--
scaffold-IHWO-2006846 GAPKDV------SN-AQNSAELDDIAQFAVDQYNT------KE------GKN---------
scaffold-LFVP-2004953 GAPKDV------SN-AQNSAELDDIAQFAVDQYNT------KE------GKN---------
scaffold-HMHL-2006230 GAPKDV------SN-AQNSAELDDIAQFAVDQYNT------KE------GKN---------
scaffold-TFYI-2002774 GAPKDV------SN-AQNSAEMDDIGQFAVDQYNT------KE------GKN---------
scaffold-JPYU-2004649 GAPKDV------SN-AQNSVEMDDMGRFAVDQYNT------KE------GKN---------
scaffold-ILBQ-2044252 GAPKDV------SH-SENSAELDGIGQFAVDQYNS------KE------GKN---------
scaffold-WJLO-2005073 GGPKDV------SN-AENNAELDDIGQFAVEQYNN------KE------GKN---------
scaffold-TXVB-2072260 GAPKEV------SS-SENSTEMEEIGQYAVDQYNT------KE------GKS---------
scaffold-TFDQ-2117991 GAPQDV------NL-GGNGDELHDIGKYAVEQYNS------KN------GKN---------
scaffold-HERT-2005449 GAPMDM------TN-TENSLELDSLGQFAVDQHNS------KE------GKS---------
scaffold-WJLO-2000597 GGITNV------TD-PENNAELINIGRFAVKEYNK------EA------NKN---------
scaffold-JHFI-2012131 GGRTDV------KN-IENSLEIDEIGRFAVEQHNT------KE------GTK---------
scaffold-PIUF-2003790 GGRTEV------KN-VENSLEIDEIGRFAVEQHNA------KE------GNK---------
scaffold-PIUF-2008236 GGPKDV------KN-VENSLEIDQIARYAVEQHNT------KE------GKK---------
scaffold-TGKW-2009731 GAPKEV------SS-AQNSGEIDEIAQYAVKEHNT------KE------GKN---------
scaffold-TGKW-2009732 GAPKEV------SS-AQNSGEIDEIAQYAVKEHNT------KE------GKN---------
scaffold-CHJJ-2010951 GAPKEV------SS-AQNSGEIDDIAQYAVKEHNS------KE------GKN---------
scaffold-CHJJ-2010953 GGPKEV------SS-AQNSGEIDEIAQYAVKEHNT------KE------GKN---------
scaffold-HPXA-2133243 GAPKEV------KN-SENALEIDDVAQFAVKEHNT------KE------GKN---------
scaffold-KRUQ-2012852 GAPKEV------KN-SENSAEIDEIAKFAVTEHNT------KE------GKN---------
scaffold-UUHD-2007235 GAPKEV------KN-SENSVEIDEIAKFAVNEHNT------KE------GKN---------
scaffold-LGOW-2011418 GAPKEV------KN-SQNTLEIEEIAKFAVQEHNS------KE------GKK---------
scaffold-BPSG-2014883 GAPKEV------KS-SENSEEIQDIAKF---QHNT------KE------GKN---------


scaffold-RTMU-2011541
scaffold-YBQN-2011859
scaffold-IRBN-2006002
scaffold-OFTV-2013736
scaffold-FITN-2015102
sp|Q0JGM8|CYT5_ORYSJ_
sp|Q5N806|CYT4_ORYSJ_
sp|Q8L5T9|CYT2_ARATH_
sp|Q84WT8|CYT4_ARATH_
sp|Q10Q46|CYT6_ORYSJ_
sp|Q41916|CYT5_ARATH_
70
80
90
100
110
120
scaffold-MIRS-2008031
scaffold-MIRS-2008032
scaffold-TMAJ-2019727
scaffold-QMWB-2008409
scaffold-QKQO-2008112
scaffold-WSPM-2006582
scaffold-LNSF-2007974
scaffold-JADL-2004394
scaffold-VBMM-2007670
scaffold-TAVP-2004418
scaffold-EEMJ-2002315
scaffold-VMXJ-2122334
scaffold-CMEQ-2005502
scaffold-IGUH-2008923
scaffold-ZACW-2006653
scaffold-ZACW-2006654
scaffold-JMXW-2002543
scaffold-XWHK-2007712
scaffold-HVBQ-2014633
scaffold-WNGH-2084702
scaffold-VMXJ-2001610
scaffold-ZQRI-2010041
scaffold-HVBQ-2014846
scaffold-YEPO-2016840
scaffold-KEFD-2009651
scaffold-XWHK-2045295
scaffold-FFPD-2010143
scaffold-RDOO-2014072
scaffold-ABCD-2074242
scaffold-RDOO-2014071
scaffold-YEPO-2077370
scaffold-YEPO-2076688
scaffold-ZQRI-2012280
scaffold-RGKI-2007331
scaffold-VMXJ-2126173
scaffold-NGTD-2003224
scaffold-YWNF-2010546
scaffold-WNGH-2085150
scaffold-CMEQ-2001993
scaffold-JMXW-2038855
scaffold-XWHK-2045439
scaffold-BGXB-2003214
scaffold-DHWX-2002000
scaffold-DHWX-2002001
scaffold-VMXJ-2000130
scaffold-LNSF-2064059
scaffold-IGUH-2162871
scaffold-ZACW-2095198
scaffold-WSPM-2042882
scaffold-JADL-2044003


scaffold-MIRS-2083994 ------LSFSKVISAHTQVVQGTMYHLVIEA-------VEA--SKPSQYEAQVWVKPWEN
scaffold-HVBQ-2125838 ------LSFSKVISAHTQVVQGTMYHLVIEA-------EEA--SKPSQYEAQVWVKPWEN
scaffold-QKQO-2045914 ------LSFSKVISAHTQVVQGTMYHLVIEA-------EEA--SKPGQYEAKVWVKPWEN
scaffold-EEMJ-2034540 ------LSFSKVISAHTQVVQGTMYHLVIEA-------EEA--NKPSQYEAQVWVKPWEN
scaffold-VBMM-2049218 ------LSFSKVISAHTQVVQGTMYHLVIEA-------EEA--SKPSQYEAQVWVKPWEN
scaffold-QMWB-2057440 ------LSFSKVISAHTQVVQGTMYHLVIEA-------EEA--SKPSQYEAQVWVKPWEN
scaffold-TMAJ-2177571 ------LSFSKVISAHTQVVQGTMYHLLIEA-------EEA--SKPSQYEAQVWVKPWEN
scaffold-SZYG-2009049 ------LTFSKVVSAHKQVVQGTMYYLVIEV-------TED--NKPKEYEAKVWVKPWEN
scaffold-RCBT-2185197 ------LSFSKVVSARTQVVQGTMYHLTIEV-------QES--GNPKLYEAKVWVKPWEN
scaffold-GOWD-2014353 ------LTFSKVVSAKKQVVQGTLYHLTIEV-------QEA--GKPKLYDAKVWVKPWEN
scaffold-RCBT-2018697 ------LTFSKVVSAKKQVVQGTIYHLTIEV-------QEA--GDPKLYDAKVWVKPWEN
scaffold-UHLI-2016615 ------LTFSKVVSAKKQVVQGTVYHLTIEV-------QEA--GNPKLYDAKVWVKPWEN
scaffold-SKQD-2012376 ------LSFSKVVSAKQQVVQGTMYHLTIEV-------LEA--NKPKLYDAKVWVKAWEN
scaffold-RCBT-2003187 ------LSFSKVVSAREQVVAGTMYYLRIVV-------LES--GTPKLYDCKIWVKPWEN
scaffold-ABCD-2010763 ------ISFSKVLSAQEQVVQGTMYYLTIEV-------MEG--GVAKQYDAKVWVKPWEG
scaffold-RDOO-2002046 ------ISFSKVLSAQEQVVQGTMYYLTIEV-------MEG--GVAKQYDAKVWVKPWEG
scaffold-RDOO-2002048 ------ISFSKVLSAKEQVVQGTMYYLTIEV-------MEG--GVAKQYDAKVWVKPWEG
scaffold-NGTD-2009620 ------ISFSKVLSAKEQVVQGTMYYLTIEV-------LED--GVAKQYDAKVWVKPWEG
scaffold-RGKI-2010169 ------ISFSKVLSAKEQVVQGTMYYLTIEV-------MEG--GVAKQYNAKVWVKPWEG
scaffold-VMXJ-2117007 ------ISFSKVLSAKEQVVQGTMYYLTIEV-------MEG--GVAKQYNAKVWVKPW--
scaffold-KEFD-2058520 ------ISFSKVLSAKEQVVQGTMYYLTIEV-------MEG--GAPKQYDAKVWVKPWEG
scaffold-ZQRI-2012183 ------ISFSKVLSAKSQVVQGTMYYLTIEV-------MED--GVPKQYDAKVWVKPWEG
scaffold-RGKI-2062405 ------ISFSKVLSAKEQVVQGTLYYLTIEV-------MEG--GVPKQYDAKVWVKPWEG
scaffold-VMXJ-2127411 ------ISFSKVLSAKEQVVQGTLYYLTIEV-------MEG--GVPKQYDAKVWVKPWEG
scaffold-AWOI-2069256 ------ISFSKVVSAKEQVVQGTMYYLTIEV-------MEN--GVPKEYDAKVWVKPWEG
scaffold-YEPO-2076541 ------ITFSKVLSAKEQVVQGTMYYFTIEV-------MEN--GVPKNYDAKVWVKPWEG
scaffold-FFPD-2012477 ------ISFSKVVSAKEQVVQGTMYYLTVEV-------LED--GVAKQYDAKVWVKPWEG
scaffold-FFPD-2012478 ------ISFSKVVSAKEQVVQGTMYYLTVEV-------LED--GVAKQYDAKVWVKPWEG
scaffold-HVBQ-2128747 ------MSFSKVVAAKEQVVAGTMYYLTVEV-------NEG--GAKKLYDAKVWVKPWED
scaffold-SZYG-2041372 ------MTFSKVVAAKEQVVQGTMYYLTVEV-------MED--GKPKLYDAKVWVKPWEG
scaffold-ZTHV-2081931 ------MTFSKVVAAKEQVVQGTMYYLTVEV-------MED--GKPKLYDAKVWVKPWEG
scaffold-FFPD-2012479 ------ISFSKVVSAKEQVVQGTMYYLTIEV-------VEG--GEPKLYDAKVWVKPWEG
scaffold-NGTD-2000698 ------MLFSRALSAKEQVVQGTMYYLTIEV-------IQC--GEPK-YDAQVWVKPWEG
scaffold-RDOO-2017879 ------ISFSKVLSVKEQVVQGTMYYLTIEV-------MKG--GKPKLYDAKVWVKPWQG
scaffold-YWNF-2047866 ------ISFSKVLSAKEQVVQGTMYYLTIEV-------LES--GVPKHYDAKVWVKPWEG
scaffold-CMEQ-2080792 ------ISFSKVLSAKEQVVQGTMYYLTIEV-------LED--GTPKQYDAKVWVKPWQG
scaffold-JMXW-2040905 ------ISFSKLLSAKEQVVQGTMYYLTIEV-------LEG--GVPKQYDAKVWVKPWED
scaffold-XWHK-2045704 ------ISFSKVLSAKEQVVQGTMYYLTIEV-------LEG--GVPKQYDAKVWVKPWED
scaffold-BGXB-2076402 ------ISFSKVLAAEEQVVQGTMYYLTIEV-------MEG--GVPKKYDAKVWVKPWEG
scaffold-ORKS-2009074 ------ISFSKVLSAKEQVVQGTMYYLTIEV-------MEG--GVPKQYDAKVWVKPWEG
scaffold-HVBQ-2125200 ------IAFSKVLAAKEQVVQGTMYYLTIEV-------KEG--GVPKQYDAKVWVKPWEG
scaffold-WNGH-2085708 ------IAFSKVLAAKEQVVQGTMYYLTIEV-------MEG--GVPKQYDAKVWVKPWEG
scaffold-DHWX-2010955 ------ISFSKVLAAKEQVVQGTMYYLTVEV-------MEG--GVPKQYEAKVWVKPWEN
scaffold-MIRS-2084743 ------ISFSKVLAAKEQVVQGTMYYLTVEV-------MEG--GVPKQYEAKVWVKPWEG
scaffold-WSPM-2044186 ------ISFSKVLGAKEQVVQGTMYYLTVEV-------MEG--GVPKQYEAKVWVKPWEG
scaffold-QMWB-2005435 ------ISFSKVLAAKEQVVQGTMYYLTVEV-------VEG--GVPKQYEAKVWVKPWED
scaffold-TMAJ-2179486 ------ISFSKVLAAKEQVVQGTMYYLTVEV-------MEG--GVPKQYEAKVWVKPWED
scaffold-JADL-2045067 ------ISFTKVLAAKEQVVQGTMYYLTVEV-------TEG--GVPKQYEAKVWVKPWEN
scaffold-IGUH-2159625 ------ISFSKVLAAKEQVVQGTMYYLTVEV-------TEG--GVPKQYEAKVWVKPWEG
scaffold-ZACW-2096043 ------ISFSKVLAAKEQVVQGTMYYLTVEV-------TEG--GVPKQYEAKVWVKPWEG
scaffold-QKQO-2046228 ------ISFSKVLGAKEQVVQGTMYYLTVEV-------TEG--GVPKQYEAKVWVKSWEN
scaffold-LNSF-2065621 ------ISFSKVLAAKEQVVQGTMYYLTVEV-------MEG--GVPKQYEAKVWVKPWEG
scaffold-EEMJ-2036252 ------ISFSKVLAVKEQVVQGTMYYLTVEV-------MEG--GVPKRYEAKVWVKPWEG
scaffold-TAVP-2017134 ------ISFSKVLAAKEQVVQGTMYYLTVEV-------MEG--GVPKQYEAKVWVKPWEG
scaffold-VBMM-2050119 ------ISFSKVLAAKEQVVQGTMYYLTVEV-------MEG--GVPKQYEAKVWVKPWEG
scaffold-BNCU-2084976 ------LTLKKVVSAQKQVVSGTMYHLKLEV-------HES--DQPKLFEAKVWTKPWEN
scaffold-DXOU-2006128 ------LSFSRLLKAQQQVVAGMMYHLTIEV-------KKG--GEAEVWEAQVWSKPWEK
scaffold-TCBC-2013516 ------LSFSRLLKAQQQVVAGMMYHLTIEV-------KKA--GEAEVWEAQVWSKPWEK
scaffold-ZFRE-2112727 ------LRFSKVLSAQEQVVAGMNYDLTLEV------VPEGQNEEPEVWEAEVYTVPWEH
scaffold-BSNI-2047531 ------LCFSKVLSAQQQVVQGIMYYLTLEA------VPEGKNGEQEVWEAQVWSKPWEK
scaffold-RXRQ-2007909 ------LCFSKVLSAQQQVVQGIMYYLTLEA------VPEGKNGEQEVWEAQVWSKPWEK
scaffold-TWUW-2047237 ------LCFSKVLSAQQQVVQGIMYYLTLEA------VPEGKNGEQEVWEAQVWSKPWEK
scaffold-TFDQ-2008546 ------ISFRRVVAAQEQVVAGTMYYLTIEG-------EDG--GHPKLYKAKVWVKPWEN
scaffold-TFDQ-2008547 ------ISFRRVVAAQEQVVAGTMYYLTIEG-------EDG--GHPKLYKAKVWVKPWEN


scaffold-GOWD-2011650
sp|P20907|CYT2_ORYSJ_
sp|Q945Q1|CYT1_ARATH_
sp|P09229|CYT1_ORYSJ_
sp|Q41906|CYT3_ARATH_
sp|Q6I570|CYT3_ORYSJ_
sp|Q8H0X6|CYT6_ARATH_
scaffold-FITN-2004970
scaffold-IHWO-2006846
scaffold-LFVP-2004953
scaffold-HMHL-2006230
scaffold-TFYI-2002774
scaffold-JPYU-2004649
scaffold-ILBQ-2044252
scaffold-WJLO-2005073
scaffold-TXVB-2072260
scaffold-TFDQ-2117991
scaffold-HERT-2005449
scaffold-WJLO-2000597
scaffold-JHFI-2012131
scaffold-PIUF-2003790
scaffold-PIUF-2008236
scaffold-TGKW-2009731
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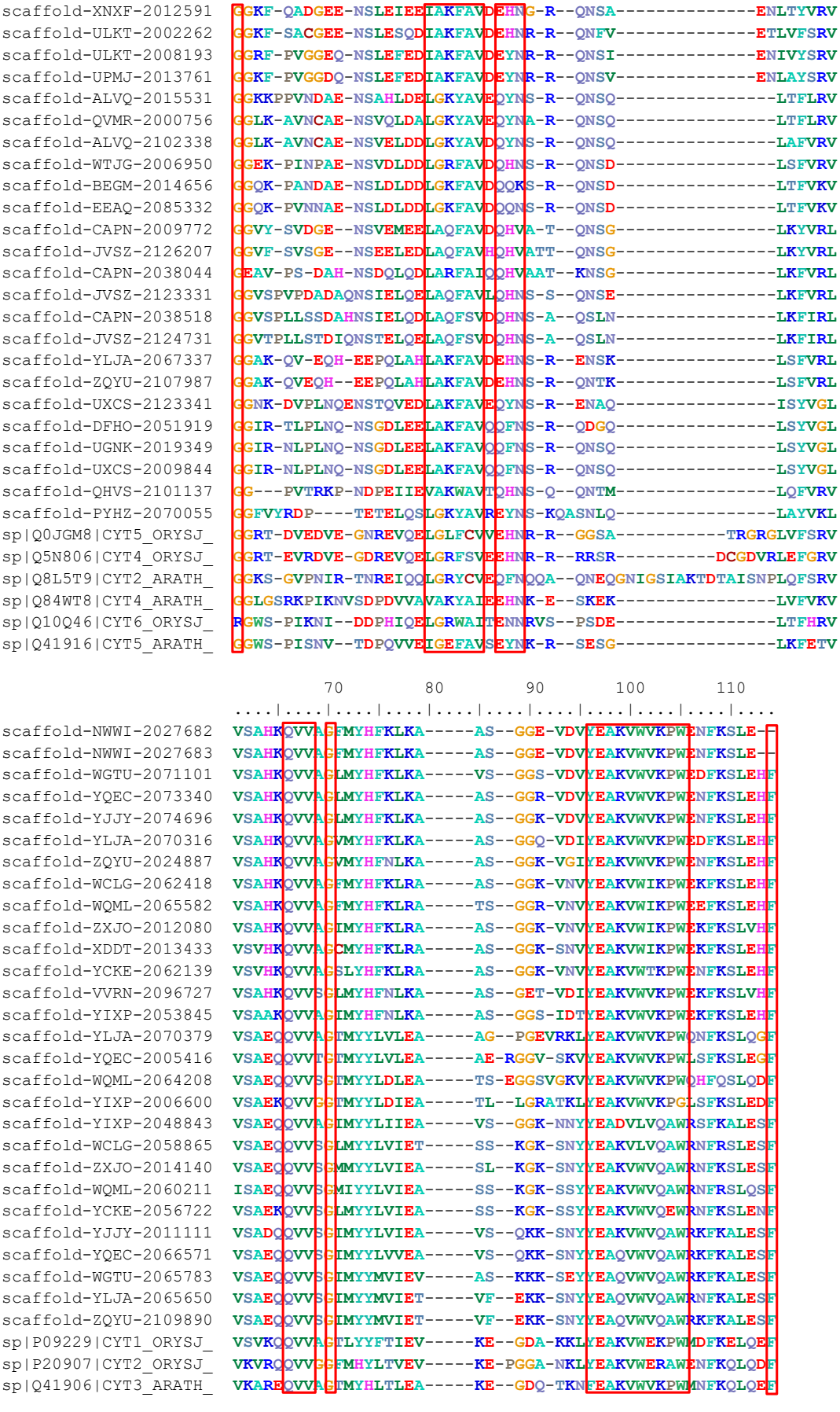
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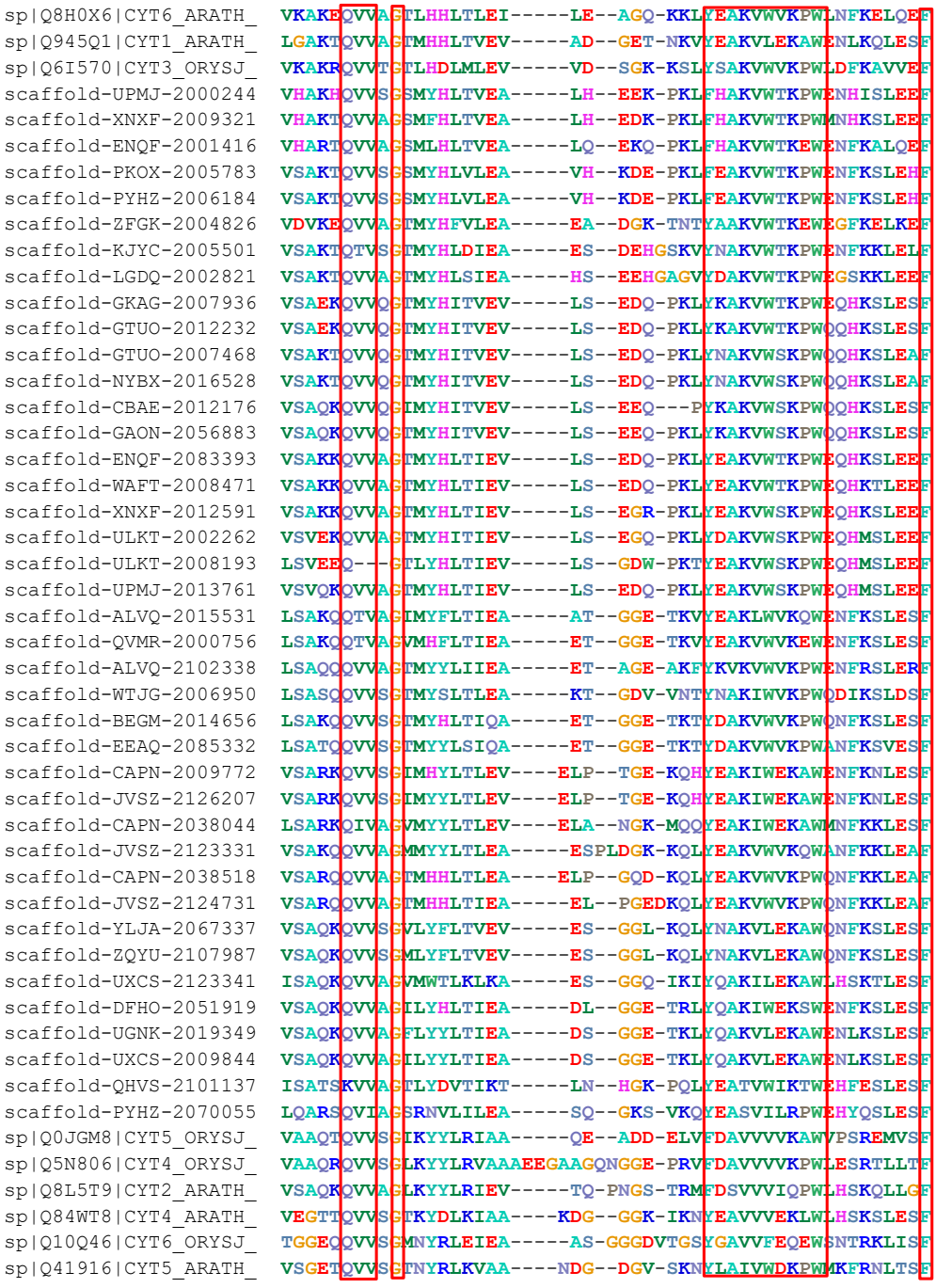
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sp|Q10Q46|CYT6_ORYSJ_  TRKLISF
sp|Q41916|CYT5_ARATH_  FRNLTSE
```

Apêndice 3C. Alinhamento das sequências identificadas em pteridófitas. As regiões destacadas são importantes para fitocistatinas.

```
                                10        20        30        40        50        60
                       ....|....|....|....|....|....|....|....|....|....|....|....|
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scaffold-ZXJO-2012080  GGLQ-EVPAAQ-NDLEAQDLAKFAINEHNS-R--QNSD----------------LEYEGI
scaffold-XDDT-2013433  GGLQ-EVPAAQ-NDLEAQDLAKFAIDEHNS-R--QNLD--------------------I
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scaffold-VVRN-2096727  GGLE-EIPAAQ-NHLEVEDLAKFAVDQHNS-K--QNSD----------------LTYAGI
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scaffold-WQML-2064208  GARQ-KIADAQ-NNLQLQTLAKFAVDQHNA-K--QNSS----------------LVYERL
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