AMB Express

Supplemental information for

Characterization of FsXEG12A from the cellulose-degrading ectosymbiotic fungus *Fusarium* spp. strain EI cultured by the ambrosia beetle

Kiyota Sakai[1], Aya Yamaguchi[1], Seitaro Tsutsumi[1], Yuto Kawai[1], Sho Tsuzuki[1], Hiromitsu Suzuki[1], Sadanari Jindou[2], Yoshihito Suzuki[3], Hisashi Kajimura[3], Masashi Kato[1], Motoyuki Shimizu[1]*

[1] *Faculty of Agriculture, Meijo University, Nagoya, Aichi, 468-8502, Japan*

[2] *Faculty of Science and Technology, Meijo University, Nagoya, Aichi, 468-8502, Japan*

[3] *Graduate School of Bioagricultural Sciences, Nagoya University, Nagoya, Aichi, 464-8601, Japan*

*Corresponding author. Tel/Fax: +81-52-838-2445

E-mail: moshimi@meijo-u.ac.jp (M. Shimizu)

Table S1. Identification of the cellulolytic enzyme produced by *Fusarium* spp. strain EI

Annotation name	Gene ID[a]	PMF search			MS/MS ion search
		Score	MW[b]	Cov.[c]	Identified peptide sequence
Hypothetical protein	EMT67806.1	127	20.9	54	GSYTVSGLGQR, TYDAANFGLFK

[a]Protein name and accession numbers were obtained from the NCBI protein database.

[b]Theoretical mass.

[c]Sequence coverage (%) in peptide mass fingerprinting (PMF).

Table S2. Substrate specificity of the purified GH12 enzyme

Substrate	Specific activity (U/mL)	Relative activity (%)
CMC	158.9 ± 10.7	59.2
MCC	57.3 ± 9.4	21.3
Xyloglucan	268.6 ± 50.1	100
Lichenan	263.7 ± 37.5	98.2
Glucomannan	121.3 ± 14.4	45.2

Data are means ± standard deviation of three experiments. Recombinant GH12 enzyme (1.0 μM) was incubated with substrates in 50 mM acetate buffer (pH 3.0) at 37°C.

Figure S1. Nucleotide sequence alignment of *18S rRNA*.

18S rRNA sequences of *Fusarium* spp. were aligned using ClustalW. Identical nucleotides are highlighted. Dashes indicate gaps. *18S rRNA* sequences of LC534254 from *Fusarium* spp. strain EI, LT841222.1 from *F. oxysporum* f. sp. *dianthi* strain Fod001, LT841236.1 from *F. oxysporum* f. sp. *dianthi* strain Fod008, LT841208.1 from *F. oxysporum* f. sp. *cumini* strain F11, LT841250.1 from *F. proliferatum* strain ITEM2287, LT841264.1 from *F. proliferatum* strain ITEM2400, KC866343.1 from *F. sporotrichioides* isolate CHILEFUS1, KC866344.1 from *F. sporotrichioides* isolate CHILEFUS2, KP310124.1 from *F. solani* strain XXG-2, EF397944.1 from *F. solani* strain 421502, KX132128.1 from *F. graminearum* strain CBE330.6, and KX132126.1 from *F. graminearum* strain CBE330.5 are shown.

```
F. oxysporum f. sp. dianthi strain Fod008   CTCAAAGATTAAAGCCATGCATGTCTAAGTATAAGCAATTATCGCGCGAAA 50
F. oxysporum f. sp. dianthi strain Fod001   CTCAAAGATTAAAGCCATGCATGTCTAAGTATAAGCAATTATCGCGCGAAA 50
Fusarium spp. strain EI                     CTCAAAGATTAAAGCCATGCATGTCTAAGTATAAGCAATTATCGCGCGAAA 50
F. oxysporum f. sp. cumini strain F11       CTCAAAGATTAAAGCCATGCATGTCTAAGTATAAGCAATTATCGCGCGAAA 50
F. proliferatum strain ITEM2287             CTCAAAGATTAAAGCCATGCATGTCTAAGTATAAGCAATTATACAGCGAAA 50
F. proliferatum strain ITEM2400             CTCAAAGATTAAAGCCATGCATGTCTAAGTATAAGCAATTATACAGCGAAA 50
F. sporotrichioides isolate CHILEFUS1       ---AAAGATTAAAGCCATGCATGTCTAAGTATAAGCAATTATACAGCGAAA 47
F. sporotrichioides isolate CHILEFUS2       ---AAAGATTAAAGCCATGCATGTCTAAGTATAAGCAATTATACAGCGAAA 47
F._solani_strain_XXG-2                      ---AAAGATTAAAGCCATGCATGTCTAAGTATAAGCAATTATACAGCGAAA 47
F._solani_strain_421502                     ---AAAGATTAAAGCCATGCATGTCTAAGTATAAGCAATTATACAGCGAAA 47
F._graminearum_strain_CBE330.6              ------------GACCCGGGCATGTCCTAGTATAAGCA-TTATACAGCGAAA 37
F._graminearum_strain_CBE330.5              ------------CAACCCGGCTTGTCCTAGTATAGCAA-TTATACAGCGAAA 39

F. oxysporum f. sp. dianthi strain Fod008   CTGCGAATGGCTCATTATATAAGTTATCGTTTATTTGATAGTACCTTACT 100
F. oxysporum f. sp. dianthi strain Fod001   CTGCGAATGGCTCATTATATAAGTTATCGTTTATTTGATAGTACCTTACT 100
Fusarium spp. strain EI                     CTGCGAATGGCTCATTATATAAGTTATCGTTTATTTGATAGTACCTTACT 100
F. oxysporum f. sp. cumini strain F11       CTGCGAATGGCTCATTATATAAGTTATCGTTTATTTGATAGTACCTTACT 100
F. proliferatum strain ITEM2287             CTGCGAATGGCTCATTATATAAGTTATCGTTTATTTGATAGTACCTTACT 100
F. proliferatum strain ITEM2400             CTGCGAATGGCTCATTATATAAGTTATCGTTTATTTGATAGTACCTTACT 100
F. sporotrichioides isolate CHILEFUS1       CTGCGAATGGCTCATTATATAAGTTATCGTTTATTTGATAGTACCTTACT 97
F. sporotrichioides isolate CHILEFUS2       CTGCGAATGGCTCATTATATAAGTTATCGTTTATTTGATAGTACCTTACT 97
F._solani_strain_XXG-2                      CTGCGAATGGCTCATTATATAAGTTATCGTTTATTTGATAGTACCTTACT 97
F._solani_strain_421502                     CTGCGAATGGCTCATTATATAAGTTATCGTTTATTTGATAGTACCTTACT 97
F._graminearum_strain_CBE330.6              CTGCGAATGGCTCATTATATAAGTTATCGTTTATTTGATAGTACCTTACT 87
F._graminearum_strain_CBE330.5              CTGCGAATGGCTCATTATATAAGTTATCGTTTATTTGATAGTACCTTACT 89

F. oxysporum f. sp. dianthi strain Fod008   ACTTGGATAACCGTGGTAATTCTAGAGCTAATACATGCTAAAAATCCCGA 150
F. oxysporum f. sp. dianthi strain Fod001   ACTTGGATAACCGTGGTAATTCTAGAGCTAATACATGCTAAAAATCCCGA 150
Fusarium spp. strain EI                     ACTTGGATAACCGTGGTAATTCTAGAGCTAATACATGCTAAAAATCCCGA 150
F. oxysporum f. sp. cumini strain F11       ACTTGGATAACCGTGGTAATTCTAGAGCTAATACATGCTAAAAATCCCGA 150
F. proliferatum strain ITEM2287             ACTTGGATAACCGTGGTAATTCTAGAGCTAATACATGCTAAAAATCCCGA 150
F. proliferatum strain ITEM2400             ACTTGGATAACCGTGGTAATTCTAGAGCTAATACATGCTAAAAATCCCGA 150
F. sporotrichioides isolate CHILEFUS1       ACTTGGATAACCGTGGTAATTCTAGAGCTAATACATGCTAAAAATCCCGA 147
F. sporotrichioides isolate CHILEFUS2       ACTTGGATAACCGTGGTAATTCTAGAGCTAATACATGCTAAAAATCCCGA 147
F._solani_strain_XXG-2                      ACTTGGATAACCGTGGTAATTCTAGAGCTAATACATGCTAAAAATCCCGA 147
F._solani_strain_421502                     ACTTGGATAACCGTGGTAATTCTAGAGCTAATACATGCTAAAAATCCCGA 147
F._graminearum_strain_CBE330.6              ACTTGGATAACCGTGGTAATTCTAGAGCTAATACATGCTAAAAATCCCGA 137
F._graminearum_strain_CBE330.5              ACTTGGATAACCGTGGTAATTCTAGAGCTAATACATGCTAAAAATCCCGA 139

F. oxysporum f. sp. dianthi strain Fod008   CTTCGGAAGGGATGTATTTATTAGATTAAAAACCAATGCCCTTCGGGGGCT 200
F. oxysporum f. sp. dianthi strain Fod001   CTTCGGAAGGGATGTATTTATTAGATTAAAAACCAATGCCCTTCGGGGGCT 200
Fusarium spp. strain EI                     CTTCGGAAGGGATGTATTTATTAGATTAAAAACCAATGCCCTTCGGGGGCT 200
F. oxysporum f. sp. cumini strain F11       CTTCGGAAGGGATGTATTTATTAGATTAAAAACCAATGCCCTTCGGGGGCT 200
F. proliferatum strain ITEM2287             CTTCGGAAGGGATGTATTTATTAGATTAAAAACCAATGCCCTTCGGGGGCT 200
F. proliferatum strain ITEM2400             CTTCGGAAGGGATGTATTTATTAGATTAAAAACCAATGCCCTTCGGGGGCT 200
F. sporotrichioides isolate CHILEFUS1       CTTCGGAAGGGATGTATTTATTAGATTAAAAACCAATGCCCTCCGGGGGCT 197
F. sporotrichioides isolate CHILEFUS2       CTTCGGAAGGGATGTATTTATTAGATTAAAAACCAATGCCCTCCGGGGGCT 197
F._solani_strain_XXG-2                      CTTCGGAAGGGATGTATTTATTAGATTAAAAACCAATGCCCTCCGGGGGCT 197
F._solani_strain_421502                     CTTCGGAAGGGATGTATTTATTAGATTAAAAACCAATGCCCTCCGGGGGCT 197
F._graminearum_strain_CBE330.6              CTTCGGAAGGGATGTATTTATTAGATTAAAAACCAATGCCCTCCGGGGGCT 187
F._graminearum_strain_CBE330.5              CTTCGGAAGGGATGTATTTATTAGATTAAAAACCAATGCCCTCCGGGGGCT 189

F. oxysporum f. sp. dianthi strain Fod008   CACTGGTGATTCATGATAACTCCTCGAATCGCATGGCCTTGTGCCGGGCGA 250
F. oxysporum f. sp. dianthi strain Fod001   CACTGGTGATTCATGATAACTCCTCGAATCGCATGGCCTTGTGCCGGGCGA 250
Fusarium spp. strain EI                     CACTGGTGATTCATGATAACTCCTCGAATCGCATGGCCTTGTGCCGGGCGA 250
F. oxysporum f. sp. cumini strain F11       CACTGGTGATTCATGATAACTCCTCGAATCGCATGGCCTTGTGCCGGGCGA 250
F. proliferatum strain ITEM2287             CACTGGTGATTCATGATAACTCCTCGAATCGCATGGCCTTGTGCCGGGCGA 250
F. proliferatum strain ITEM2400             CACTGGTGATTCATGATAACTCCTCGAATCGCATGGCCTTGTGCCGGGCGA 250
F. sporotrichioides isolate CHILEFUS1       CACTGGTGATTCATGATAACTCCTCGAATCGCATGGCCTTGTGCCGGGCGA 247
F. sporotrichioides isolate CHILEFUS2       CACTGGTGATTCATGATAACTCCTCGAATCGCATGGCCTTGTGCCGGGCGA 247
F._solani_strain_XXG-2                      CACTGGTGATTCATGATAACTCCTCGAATCGCATGGCCTTGCGCCGGGCGA 247
F._solani_strain_421502                     CACTGGTGATTCATGATAACTCCTCGAATCGCATGGCCTTGCGCCGGGCGA 247
F._graminearum_strain_CBE330.6              CACTGGTGATTCATGATAACTCCTCGAATCGCATGGCCTTGCGCCGGGCGA 237
F._graminearum_strain_CBE330.5              CACTGGTGATTCATGATAACTCCTCGAATCGCATGGCCTTGCGCCGGGCGA 239

F. oxysporum f. sp. dianthi strain Fod008   TGGTTCATTCAAATTTCTTCCCTATCAAC 279
F. oxysporum f. sp. dianthi strain Fod001   TGGTTCATTCAAATTTCTTCCCTATCAAC 279
Fusarium spp. strain EI                     TGGTTCATTCAAATTTCTTCCCTATCAAC 258
F. oxysporum f. sp. cumini strain F11       TGGTTCATTCAAATTTCTTCCCTATCAAC 279
F. proliferatum strain ITEM2287             TGGTTCATTCAAATTTCTTCCCTATCAAC 279
F. proliferatum strain ITEM2400             TGGTTCATTCAAATTTCTTCCCTATCAAC 279
F. sporotrichioides isolate CHILEFUS1       TGGTTCATTCAAATTTCTTCCCTATCAAC 276
F. sporotrichioides isolate CHILEFUS2       TGGTTCATTCAAATTTCTTCCCTATCAAC 276
F._solani_strain_XXG-2                      TGGTTCATTCAAATTTCTTCCCTATCAAC 276
F._solani_strain_421502                     TGGTTCATTCAAATTTCTTCCCTATCAAC 276
F._graminearum_strain_CBE330.6              TGGTTCATTCAAATTTCTTCCCTATCAAC 266
F._graminearum_strain_CBE330.5              TGGTTCATTCAAATTTCTTCCCTATCAAC 268
```

Figure S2. Nucleotide sequence alignment of *EF-1α*.

The nucleotide sequence alignment was performed using partial *EF-1α* sequences of *Fusarium* spp. strain EI, *Fusarium* species registered in the JGI database (https://mycocosm.jgi.doe.gov/Fusarium/Fusarium.info.html) and the *Fusarium* sp. AF-3 sequence. The *EF-1α* sequences of *Fusarium* spp. were aligned using ClustalW. Identical nucleotides are highlighted. Dashes indicate gaps. *EF-1α* sequences of KC691533.1 from *Fusarium* sp. AF-3, KC691536.1 from *Fusarium* sp. AF-3, 599354 from *F. commune* MPI-SDFR-AT-0072, 8475 from *F. fujikuroi* IMI 58289, 9400 from *F. graminearum* FGSG_08811T0, 17733 from *F. oxysporum* f. sp. *lycopersici* 4287, 554906 from *F. oxysporum* MPI-SDFR-AT-0094, 4767 from *F. pseudograminearum* CS3096, 485664 from *F. solani* FSSC 5, 10379 from *F. verticillioides* 7600, and LC534255 from *Fusarium* spp. strain EI are shown.

```
F._oxysporum_f._sp._lycopersic      A T G A G - - - - - - - - - - - - - - - - - - - - C T T A - - - - - - - - - - - - - - - - - - - - 9
F._oxysporum_MPI-SDFR-AT-0094_      A T G G G T A A G G A G G A C A A G A C T C A C C T T A A C G T C G T C G T - C A T C G G C C A C G 49
F._fujikuroi_IMI_58289              A T G G G T A A G G A G G A C A A G A C T C A C C T T A A C G T C G T C G T - C A T C G G C C A C G 49
F._solani_FSSC_5                    A T G G G T A A G G A G G A C A A G A C T C A C C T C A A C G T C G T C G T - C A T C G G C C A C G 49
F._commune_MPI-SDFR-AT-0072         A T G G G T A A G G A G G A C A A G A C T C A C C T T A A C G T C G T C G T - C A T C G G C C A C G 49
F._verticillioides_7600             A T G G G T A A G G A G G A C A A G A C T C A C C T T A A C G T C G T C G T - C A T C G G C C A C G 49
F._graminearum_FGSG_08811T0         A T G G G T A A G G A G G A G A A G A C T C A C C T T A A C G T C G T C G T - C A T C G G C C A C G 49
F._pseudograminearum_CS3096         A T G G G T A A G G A G G A G A A G A C T C A C C T T A A C G T C G T C G T - C A T C G G C C A C G 49
AF-3_KC691533.1                     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - G T C G T - C A T C G G C C A C G 16
AF-3_KC691536.1                     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - G T C G T - C A T C G G C C A C G 16
Fusarium_spp._Strain_EI             - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - G T T G T G T C T C G G C C - C G 16

F._oxysporum_f._sp._lycopersic      - - - - - T C T G - - - - - - - - - C C A T C A C C G G T C A C T T G A T C T A C C A G T G C G G T 45
F._oxysporum_MPI-SDFR-AT-0094_      T C G A C T C T G G C A A G T C G A C C A C T A C C G G T C A C T T G A T C T A C C A G T G C G G T 99
F._fujikuroi_IMI_58289              T C G A C T C T G G C A A G T C G A C C A C T A C C G G T C A C T T G A T C T A C C A G T G C G G T 99
F._solani_FSSC_5                    T C G A C T C T G G C A A G T C G A C C A C C A C C A G T C A C T T G A T C T A C C A G T G C G G T 99
F._commune_MPI-SDFR-AT-0072         T C G A C T C T G G C A A G T C G A C C A C T A C C G G T C A C T T G A T C T A C C A G T G C G G T 99
F._verticillioides_7600             T C G A C T C T G G C A A G T C G A C C A C T A C C G G T C A C T T G A T C T A C C A G T G C G G T 99
F._graminearum_FGSG_08811T0         T C G A C T C T G G C A A G T C G A C C A C T A C C G G T C A C T T G A T C T A C C A G T G C G G T 99
F._pseudograminearum_CS3096         T C G A C T C T G G C A A G T C G A C C A C T A C C G G T C A C T T G A T C T A C C A G T G C G G T 99
AF-3_KC691533.1                     T C G A C T C T G G C A A G T C G A C C A C C G T A A G T C - - - - - - - - - - - - - - - - - - - 46
AF-3_KC691536.1                     T C G A C T C T G G C A A G T C G A C C A C C G T A A G T C - - - - - - - - - - - - - - - - - - - 46
Fusarium_spp._Strain_EI             T C G A C T C T G G C A A G T C G A C C A C T G T G A G T - - - - - - - - - - - - - - - - - - - - 45
                                                      *   *   *                   *   *

F._oxysporum_f._sp._lycopersic      G G T A T C G A C A A G C G A A C C A T C G A G A A A G T T C G A G A A A G G A A G C C G C C T G A G C T 95
F._oxysporum_MPI-SDFR-AT-0094_      G G T A T C G A C A A G C G A A C C A T C G A G A A A G T T C G A G A A A G G A A G C C G C C T G A G C T 149
F._fujikuroi_IMI_58289              G G T A T C G A C A A G C G A A C C A T C G A G A A A G T T C G A G A A A G G A A G C C G C C T G A G C T 149
F._solani_FSSC_5                    G G T A T C G A C A A G C G A A C C A T C G A G A A A G T T C G A G A A A G G A A G C C G C C T G A G C T 149
F._commune_MPI-SDFR-AT-0072         G G T A T C G A C A A G C G A A C C A T C G A G A A A G T T C G A G A A A G G A A G C C G C C T G A G C T 149
F._verticillioides_7600             G G T A T C G A C A A G C G A A C C A T C G A G A A A G T T C G A G A A A G G A A G C C G C C T G A G C T 149
F._graminearum_FGSG_08811T0         G G T A T C G A C A A G C G A A C C A T C G A G A A A G T T C G A G A A A G G A A G C C G C C G A G C T 149
F._pseudograminearum_CS3096         G G C A T C G A C A A G C G A A C C A T C G A G A A A G T T C G A G A A A G G A A G C C G C C G A G C T 149
AF-3_KC691533.1                     - - - - - - - - - - - - - - G A A C C C T C - - - - - - - A T C G - - - - - - - - - - C G A T C T G C T 67
AF-3_KC691536.1                     - - - - - - - - - - - - - - G A A C C C T C - - - - - - - A T C G - - - - - - - - - - C G A T C T G C T 67
Fusarium_spp._Strain_EI             - - - - - - - - - - - - - - - A C T C T C - - - - - - - C T C G A - - - - - - - - - - C A A T G A G C T 65
                                                                  *   *   *                   *   *   *                   *   *   *

F._oxysporum_f._sp._lycopersic      C G G T A A G G G T T C C T T C A A G T A C G C C T G G G T T C T T G A C A A G C T C A A G G C C G 145
F._oxysporum_MPI-SDFR-AT-0094_      C G G T A A G G G T T C C T T C A A G T A C G C C T G G G T T C T T G A C A A G C T C A A G G C C G 199
F._fujikuroi_IMI_58289              C G G T A A G G G T T C C T T C A A G T A C G C C T G G G T T C T T G A C A A G C T C A A G G C C G 199
F._solani_FSSC_5                    C G G T A A G G G T T C C T T C A A G T A C G C C T G G G T C C T T G A C A A G C T C A A G G C C G 199
F._commune_MPI-SDFR-AT-0072         C G G T A A G G G T T C C T T C A A G T A C G C C T G G G T T C T T G A C A A G C T C A A G G C C G 199
F._verticillioides_7600             C G G T A A G G G T T C C T T C A A G T A C G C C T G G G T T C T T G A C A A G C T C A A G G C C G 199
F._graminearum_FGSG_08811T0         C G G T A A G G G T T C C T T C A A G T A C G C C T G G G T T C T T G A C A A G C T C A A A G C C G 199
F._pseudograminearum_CS3096         C G G T A A G G G T T C C T T C A A G T A C G C C T G G G T T C T T G A C A A G C T C A A A G C C G 199
AF-3_KC691533.1                     C A - - - - - - - - - - T C T C G G G T - - - C G T G G A A C C T C G C C T G G C - - - - - - - - - 95
AF-3_KC691536.1                     C A - - - - - - - - - - T C T C G G G T - - - C G T G G A A C C T C G C C T G G C - - - - - - - - - 95
Fusarium_spp._Strain_EI             T A - - - - - - - - - - T C T G C C A T - - - C G T C A A T C C T G A C C A G G - - - - - - - - - 92
                                                            *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *

F._oxysporum_f._sp._lycopersic      A G C G T G A G C G T G G T A T C A C C A T C G A T A T T G C T C T C T G G A A G T T C G A G A C T 195
F._oxysporum_MPI-SDFR-AT-0094_      A G C G T G A G C G T G G T A T C A C C A T C G A T A T T G C T C T C T G G A A G T T C G A G A C T 249
F._fujikuroi_IMI_58289              A G C G T G A G C G T G G T A T C A C C A T C G A T A T T G C T C T C T G G A A G T T C G A G A C T 249
F._solani_FSSC_5                    A G C G T G A G C G T G G T A T C A C C A T C G A C A T T G C C C T C T G G A A G T T C G A G A C T 249
F._commune_MPI-SDFR-AT-0072         A G C G T G A G C G T G G T A T C A C C A T C G A T A T T G C T C T C T G G A A G T T C G A G A C T 249
F._verticillioides_7600             A G C G T G A G C G T G G T A T C A C C A T C G A T A T T C G C T C T C T G G A A G T T C G A G A C T 249
F._graminearum_FGSG_08811T0         A G C G T G A G C G T G G T A T C A C C A T T G A T A T C G C C C T C T G G A A G T T C G A G A C T 249
F._pseudograminearum_CS3096         A G C G T G A G C G T G G T A T C A C C A T T G A T A T C G C T C T C T G G A A G T T C G A G A C T 249
AF-3_KC691533.1                     A T C T C G G G C G G G G T A T - - T C A T C A - - - - - - - - - - - - - - - - - G T C - - - - A C T 123
AF-3_KC691536.1                     A T C T C G G G C G G G G T A T - - T C A T C A - - - - - - - - - - - - - - - - - G T C - - - - A C T 123
Fusarium_spp._Strain_EI             A C C T - - G G T G G G G T A T - - T T C T C A A - - - - - - - - - - - - - - - - A G T C - - - - A - - 118
                                    *   *       *   *   *   *   *   *                   *                                               *   *       *

F._oxysporum_f._sp._lycopersic      C C T C G C T A C T A T G T C A C C G T C A T T G A C G C T C C C G G T C A C C G T G A T T T C A T 245
F._oxysporum_MPI-SDFR-AT-0094_      C C T C G C T A C T A T G T C A C C G T C A T T G A C G C T C C C G G T C A C C G T G A T T T C A T 299
F._fujikuroi_IMI_58289              C C T C G C T A C T A T G T C A C C G T C A T T G A C G C T C C C G G T C A C C G T G A T T T C A T 299
F._solani_FSSC_5                    C C C C G C T A C T A T G T C A C C G T C A T T G A C G C C C C C G G C C A C C G T G A C T T C A T 299
F._commune_MPI-SDFR-AT-0072         C C T C G C T A C T A T G T C A C C G T C A T T G A C G C T C C C G G T C A C C G T G A T T T C A T 299
F._verticillioides_7600             C C T C G C T A C T A T G T C A C C G T C A T T G A C G C T C C C G G T C A C C G T G A T T T C A T 299
F._graminearum_FGSG_08811T0         C C T C G C T A C T A T G T C A C C G T C A T T G A C G C T C C C G G T C A C C G T G A T T T C A T 299
F._pseudograminearum_CS3096         C C T C G C T A C T A T G T C A C C G T C A T T G A C G C T C C C G G T C A C C G T G A T T T C A T 299
AF-3_KC691533.1                     T C A T G C T G A C A - A T C A T C - T - A C A G A C - - - - - C G G T C A C T - T G A T C T - A C 163
AF-3_KC691536.1                     T C A T G C T G A C A - A T C A T C - T - A C A G A C - - - - - C G G T C A C T - T G A T C T - A C 163
Fusarium_spp._Strain_EI             A C A T A C T G A C A - - T C G T T - T C A C A G A C - - - - - C G G T C A C T - T G A T C T - A C 158
                                    *       *   *       *       *   *   *   *       *   *   *   *   *   *   *   *       *   *   *   *   *

F._oxysporum_f._sp._lycopersic      C A A G A A C A T G A T C A C T G G T A C T T T C C C A G G C C G A T T G C G C C A T T C T C A T C A 295
F._oxysporum_MPI-SDFR-AT-0094_      C A A G A A C A T G A T C A C T G G T A C T T T C C C A G G C C G A T T G C G C C A T T C T C A T C A 349
F._fujikuroi_IMI_58289              C A A G A A C A T G A T C A C T G G T A C T T T C C C A G G C C G A T T G C G C C A T T C T C A T C A 349
F._solani_FSSC_5                    C A A G A A C A T G A T C A C T G G T A C T T T C C C A G G C C G A C T G C G C C A T T C T C A T C A 349
F._commune_MPI-SDFR-AT-0072         C A A G A A C A T G A T C A C T G G T A C T T T C C C A G G C C G A T T G C G C C A T T C T C A T C A 349
F._verticillioides_7600             C A A G A A C A T G A T C A C T G G T A C T T T C C C A G G C C G A T T G C G C C A T T C T C A T C A 349
F._graminearum_FGSG_08811T0         C A A G A A C A T G A T C A C T G G T A C T T T C C C A G G C C G A T T G C G C C A T T C T C A T C A 349
F._pseudograminearum_CS3096         C A A G A A C A T G A T C A C T G G T A C T T T C C C A G G C C G A T T G C G C C A T T C T C A T C A 349
AF-3_KC691533.1                     C A - - - - - - G T G - - C G G T G G T A - T C G A C C A A G C C G A A C - - - - - - - - - - - - C A T C - 193
AF-3_KC691536.1                     C A - - - - - - G T G - - C G G T G G T A - T C G A C C A A G C C G A A C - - - - - - - - - - - - C A T C - 193
Fusarium_spp._Strain_EI             C A - - - - - - G T G - - C G G T G G T A - T C G A C C A A G C C G A A C - - - - - - - - - - - - C A T C - 188
                                    *   *               *   *       *       *   *   *   *   *       *       *   *   *       *                   *   *   *   *
```

```
F._oxysporum_f._sp._lycopersic   TTGCCGCCGGGTACTGGGTGAGTTCGAGGCCTGGGTATCTCTCCAAGGGATGGCCCAG 345
F._oxysporum_MPI-SDFR-AT-0094_   TTGCCGCCGGGTACTGGGTGAGTTCGAGGCCTGGGTATCTCTCCAAGGGATGGCCCAG 399
F._fujikuroi_IMI_58289           TTGCCGCCGGGTACTGGGTGAGTTCGAGGCCTGGGTATCTCTCCAAGGGATGGCCCAG 399
F._solani_FSSC_5                 TTGCCGCCGGGTACTGGGTGAGTTCGAGGCCTGGGTATCTCTCCAAGGGATGGCCCAG 399
F._commune_MPI-SDFR-AT-0072      TTGCCGCCGGGTACTGGGTGAGTTCGAGGCCTGGGTATCTCTCCAAGGGATGGCCCAG 399
F._verticilliodes_7600           TTGCCGCCGGGTACTGGGTGAGTTCGAGGCCTGGGTATCTCTCCAAGGGATGGCCCAG 399
F._graminearum_FGSG_08811T0      TTGCCGCCGGGTACTGGGTGAGTTCGAGGCCTGGGTATCTCTCCAAGGGATGGCCCAG 399
F._pseudograminearum_CS3096      TTGCCGCCGGGTACTGGGTGAGTTCGAGGCCTGGGTATCTCTCCAAGGGATGGCCCAG 399
AF-3_KC691533.1                  ------------------GAGAAGTTCGAG----------------AAGGGTTGGTGA- 216
AF-3_KC691536.1                  ------------------GAGAAGTTCGAG----------------AAGGGTTGGTGA- 216
Fusarium_spp._Strain_EI          ------------------GAGAAGTTCGAG----------------AAGGGTTAGTCA- 211
                                                    *  *  *  *  *  *                *  *  *  *
                                                    *                                *

F._oxysporum_f._sp._lycopersic   ACCCGTGAGCACGCTCTTCTTGCCTACACCCCTTGGTGTCAAGAACCTCATT 395
F._oxysporum_MPI-SDFR-AT-0094_   ACCCGTGAGCACGCTCTTCTTGCCTACACCCCTTGGTGTCAAGAACCCTCATT 449
F._fujikuroi_IMI_58289           ACCCGTGAGCACGCTCTTCTTGCCTACACCCCTTGGTGTCAAGAACCTCATT 449
F._solani_FSSC_5                 ACCCGTGAGCACGCCCTGCCTCGCCTACACCCCTCGGTGTCAAGAACCCTCATT 449
F._commune_MPI-SDFR-AT-0072      ACCCGTGAGCACGCTCTTCTTGCCTACACCCCTTGGTGTCAAGAACCCTCATT 449
F._verticilliodes_7600           ACCCGTGAGCACGCTCTTCTTGCCTACACCCCTCGGTGTCAAGAACCCTCATT 449
F._graminearum_FGSG_08811T0      ACCCGTGAGCACGCTCTCCTTGCCTACACCCCTTGGTGTCAAGAACCCTCATT 449
F._pseudograminearum_CS3096      ACCCGTGAGCACGCTCTTCTTGCCTACACCTCTTGGTGTCAAGAACCCTCATT 449
AF-3_KC691533.1                  ----------------CATCT----------CCCCCG----------------AT 229
AF-3_KC691536.1                  ----------------CATCT----------CCCCCG----------------AT 229
Fusarium_spp._Strain_EI          ----------------CTTTC----------CCTTCG----------------AT 224
                                                 *                *    *                 * *

F._oxysporum_f._sp._lycopersic   TGTCGCCATCAACAAGAATGGACACCACCAAAGTGGTCTGAGGCCCCGTTACC 445
F._oxysporum_MPI-SDFR-AT-0094_   TGTCGCCATCAACAAGAATGGACACCACCAAAGTGGTCTGAGGCCCCGTTACC 499
F._fujikuroi_IMI_58289           CGTCGCCATCAACAAGAATGGACACCACCAAAGTGGTCTGAGGCCCCGTTACC 499
F._solani_FSSC_5                 TGTCGCCATCAACAAGAATGGACACCACCAAAGTGGTCCGAGTCCCCGTTACC 499
F._commune_MPI-SDFR-AT-0072      CGTCGCCATCAACAAGAATGGACACCACCAAAGTGGTCTGAGGCCCCGTTACC 499
F._verticilliodes_7600           CGTCGCCATCAACAAGAATGGACACCACCAAAGTGGTCTGAGGCCCCGTTACC 499
F._graminearum_FGSG_08811T0      TGTTGCCATCAACAAGAATGGACACCACCAAAGTGGTCTGAGGCCCCGTTACC 499
F._pseudograminearum_CS3096      TGTTGCCATCAACAAGAATGGACACCACCAAAGTGGTCTGAGGCCCCGTTACC 499
AF-3_KC691533.1                  CG-CGCCTT-------------GCTATC-------CCACATCGAATTCCCC 258
AF-3_KC691536.1                  CG-CGCCTT-------------GCTATC-------CCACATCGAATTCCCC 258
Fusarium_spp._Strain_EI          CG-CGC----------------------GT-------C-------CT-------TTGCC 239
                                   *  *                              *       *       *  *  *  *

F._oxysporum_f._sp._lycopersic   AGGAGATCATCAAGGAGACCTCCCTCTTTCATCAAGAAGGTCGGGCTACAACAC 495
F._oxysporum_MPI-SDFR-AT-0094_   AGGAGATCATCAAGGAGACCTCCCTCTTTCATCAAGAAGGTCGGGCTACAACAC 549
F._fujikuroi_IMI_58289           AGGAGATCATCAAGGAGACCTCCCTCTTTCATCAAGAAGGTCGGGCTACAACAC 549
F._solani_FSSC_5                 AGGAGATCATCAAGGAGACCTCCCAACTTTCATCAAGAAGGTCGGGCTACAACAC 549
F._commune_MPI-SDFR-AT-0072      AGGAGATCATCAAGGAGACTTCTTTTTCATCAAGAAGGTCGGGCTACAACAC 549
F._verticilliodes_7600           AGGAAATCATCAAGGAGACCTCCCTCTTTCATCAAGAAGGTCGGGCTACAACAC 549
F._graminearum_FGSG_08811T0      AGGAGATCATCAAGGAGACCTCTTCTTTCATCAAGAAGGTCGGGCTACAACAC 549
F._pseudograminearum_CS3096      AGGAGATCATCAAGGAGACCTCCCTCTTTCATCAAGAAGGTCGGGCTACAACAC 549
AF-3_KC691533.1                  ------CGTC----GAATTCCCTCCCC-----------------TCACGAT 281
AF-3_KC691536.1                  ------CGTC----GAATTCCCTCCCC-----------------TCACGAT 281
Fusarium_spp._Strain_EI          ------CATC----GATTTCCC-------------------------CTACGAC 258
                                       *  *      *  *  *                          *

F._oxysporum_f._sp._lycopersic   CCCAAGGCTGTCGCTTTCGTCCCCCATCTTCCGGTTTCAACGGGTGACAACAT 545
F._oxysporum_MPI-SDFR-AT-0094_   CCCAAGGCTGTCGCTTTCGTCCCCCATCTTCCGGTTTCAACGGGTGACAACAT 599
F._fujikuroi_IMI_58289           CCCAAGGCTGTCGCTTTCGTCCCCCATCTTCCGGTTTCAACGGGTGACAACAT 599
F._solani_FSSC_5                 CCCAAGGCTGTCGCTTTCGTCCCCCATCTTCCGGTTTCAACGGGCGACAACAT 599
F._commune_MPI-SDFR-AT-0072      CCCAAGGCTGTCGCTTTCGTCCCCCATCTTCCGGTTTCAACGGGTGACAACAT 599
F._verticilliodes_7600           CCCAAGGCTGTCGCTTTCGTCCCCCATCTTCCGGCTTCAACGGGTGACAACAT 599
F._graminearum_FGSG_08811T0      CCCAAGGCTGTCGCTTTCGTCCCCCATCTTCCGGTTTCAACGGGTGACAACAT 599
F._pseudograminearum_CS3096      CCCAAGGCTGTCGCTTTCGTCCCCCATCTTCCGGTTTCAACGGGTGACAACAT 599
AF-3_KC691533.1                  CC----------------------------------------GCGCTGC 290
AF-3_KC691536.1                  CC----------------------------------------GCGCTGC 290
Fusarium_spp._Strain_EI          TC----------------------------------------GAAACGT 267
                                   *

F._oxysporum_f._sp._lycopersic   GCTTACCCCCTCCACCCAACTGCCCCTGGTACAAGGGGTTGGGAGCGTGAGA 595
F._oxysporum_MPI-SDFR-AT-0094_   GCTTACCCCCTCCACCCAACTGCCCCTGGTACAAGGGGTTGGGAGCGTGAGA 649
F._fujikuroi_IMI_58289           GCTTACCCCCTCCACCCAACTGCCCCTGGTACAAGGGGTTGGGAGCGTGAGA 649
F._solani_FSSC_5                 GCTTACTCCCTCCACCCAACTGCCCCTGGTACAAGGGCTGGGAGCGTGAGA 649
F._commune_MPI-SDFR-AT-0072      GCTTACCCCCTCCACCCAACTGCCCCTGGTACAAGGGGTTGGGAGCGTGAGA 649
F._verticilliodes_7600           GCTTACCCCCTCCACCCAACTGCCCTTGGTACAAGGGGTTGGGAGCGTGAGA 649
F._graminearum_FGSG_08811T0      GCTTACTGCCTCCACCCAACTGCCCCTGGTACAAGGGGTTGGGAGCGTGAGA 649
F._pseudograminearum_CS3096      GCTTGCCCCTCCACCCAACTGCCCCTGGTACAAGGGGTTGGGAGCGTGAGA 649
AF-3_KC691533.1                  GCCCGCTTCTCC---CGA--GTCC----CAAAAATTTTTGCGGGTGCGA--328
AF-3_KC691536.1                  GCCCGCTTCTCC---CGA--GTCC----CAAAAATTTTTGCGGGTGCGA--328
Fusarium_spp._Strain_EI          ACCCGCTACCCC---CGA--GACC----AAAAAATTTT-GCAAATATGA--307
                                   *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *
```

```
F._oxysporum_f._sp._lycopersic   TCAAGTCCGGCAAGCTCAGTGGCAAGACCCTCCTCGAGGCCATTGACTCC 645
F._oxysporum_MPI-SDFR-AT-0094_   TCAAGTCCGGCAAGCTCAGTGGCAAGACCCTCCTCGAGGCCATTGACTCC 699
F._fujikuroi_IMI_58289           TCAAGTCCGGCAAGCTTTCTGGCAAGACCCTCCTCGAGGCCATTGACTCC 699
F._solani_FSSC_5                 TCAAGTCCGGCAAGCTCTCCGGCAAGACCCTCCTCGAGGCCATTGACTCC 699
F._commune_MPI-SDFR-AT-0072      TCAAGTCCGGCAAGCTCACTGGCAAGACCCTCCTCGAGGCCATTGACTCC 699
F._verticillioides_7600          TCAAGTCCGGCAAGCTCACTGGCAAGACCCTCCTCGAGGCCATCGACTCC 699
F._graminearum_FGSG_08811T0      TCAAGTCTGGCAAGCTCTCCGGAAAGACCCTCCTTGAGGCCATTGACTCC 699
F._pseudograminearum_CS3096      TCAAGTCTGGCAAGCTCTCCGGAAAGACCCTCCTTGAGGCCATTGACTCC 699
AF-3_KC691533.1                  ----------CCGTGAATTTTTTTGGTGGGGCATTTTT----------ACCCC 361
AF-3_KC691536.1                  ----------CCGTGAATTTTTTTGGTGGGGCATTTTT----------ACCCC 361
Fusarium_spp._Strain_EI          ----------CCG--AATTTTTTTGGTGGGGCACT--T----------ACCCC 337
                                            * *   * *     *     * *   *   *   *   *   * *

F._oxysporum_f._sp._lycopersic   ATCGAGCCCCCCAAGCGTCCCGTTGACAAGCCCCCTCCCGTCTTCCCCCTCCA 695
F._oxysporum_MPI-SDFR-AT-0094_   ATCGAGCCCCCCAAGCGTCCCGTTGACAAGCCCCCTCCCGTCTTCCCCCTCCA 749
F._fujikuroi_IMI_58289           ATCGAGCCCCCCAAGCGTCCCGTTGACAAGCCCCCTCCCGTCTTCCCCCTCCA 749
F._solani_FSSC_5                 ATCGAGCCCCCCAAGCGTCCCGTCGACAAGCCCCCTCCCGACTTCCCCCTCCA 749
F._commune_MPI-SDFR-AT-0072      ATCGAGCCCCCCAAGCGTCCCGTTGACAAGCCCCCTCCCGTCTTCCCCCTCCA 749
F._verticillioides_7600          ATCGAGCCCCCCAAGCGTCCCGTTGACAAGCCCCCTTCGTCTTCCCCCTCCA 749
F._graminearum_FGSG_08811T0      ATCGAGCCCCCCAAGCGTCCCAACGACAAGCCCCCTCCCGACTTCCCCCTCCA 749
F._pseudograminearum_CS3096      ATCGAGCCCCCCAAGCGTCCCAACGACAAGCCCCCTCCCGACTTCCCCCTCCA 749
AF-3_KC691533.1                  -----GCCACTCGGGACC--GTTGGACAAAGCCCCTGATCCCTGCACACCA 404
AF-3_KC691536.1                  -----GCCACTCGGGCCGAC--GTTGGACAAAGCCCCTGATCCCTGCACACCA 404
Fusarium_spp._Strain_EI          -----GCCACTTGAGCCGAC--G-------GGAGCGTTTGCCCCTCTTAACCCA 374
                                        * * *   * * *   *                 *   *     * *

F._oxysporum_f._sp._lycopersic   GGATGTCTACAAGATCGGTGGTATTGGAACGGTTCCCGTCGGCCGTATCG 745
F._oxysporum_MPI-SDFR-AT-0094_   GGATGTCTACAAGATCGGTGGTATTGGAACGGTTCCCGTCGGCCGTATCG 799
F._fujikuroi_IMI_58289           GGATGTCTACAAGATCGGTGGTATTGGAACGGTTCCCGTCGGCCGTATCG 799
F._solani_FSSC_5                 GGATGTCTACAAGATCGGTGGTATTGGCACGGTTCCCGTCGGCCGTATCG 799
F._commune_MPI-SDFR-AT-0072      GGATGTCTACAAGATCGGTGGTATTGGAACGGTCCCCGTCGGCCGTATCG 799
F._verticillioides_7600          GGATGTCTACAAGATCGGTGGTATTGGAACGGTTCCCGTCGGCCGTTCG 799
F._graminearum_FGSG_08811T0      GGATGTCTACAAGATTGGCCGGTATTGGAACGGTTCCCTGTCGGCCGTATCG 799
F._pseudograminearum_CS3096      GGATGTCTACAAGATCGGTGGTATTGGAACGGTTCCCTGTCGGCCGTATCG 799
AF-3_KC691533.1                  AAAA---CACCAAA----------CCCCTCTTG 423
AF-3_KC691536.1                  AAAA---CACCAAA----------CCCCTCTTG 423
Fusarium_spp._Strain_EI          TTCT---CAC--AA----------CCCTCAAT G 391
                                       * *   *                     * *     *

F._oxysporum_f._sp._lycopersic   AGACTGGTGTCATCAAGCCCCGGTATGGTCGTTACCCTTCGCTCCCTTCCAAC 795
F._oxysporum_MPI-SDFR-AT-0094_   AGACTGGTGTCATCAAGCCCCGGTATGGTCGTTACCCTTCGCTCCCTTCCAAC 849
F._fujikuroi_IMI_58289           AGACTGGTGTCATCAAGCCCCGGTATGGTCGTTACCCTTCGCTCCCTTCCAAC 849
F._solani_FSSC_5                 AGACTGGTGTCATCAAGCCCCGGTATGGTCGTTACCCTTCGCCCCCCTCCAAC 849
F._commune_MPI-SDFR-AT-0072      AGACTGGTGTCATCAAGCCCCGGTATGGTCGTTACCCTTCGCCTCCCTTCTAAC 849
F._verticillioides_7600          AGACTGGTGTCATCAAGCCCCGGTATGGTCGTTACCCTTCGCCTCCCTTCCAAC 849
F._graminearum_FGSG_08811T0      AGACTGGTATCATCAAGCCCCGGTATGGTCGTTACCCTTCGCCTCCCTTCCAAC 849
F._pseudograminearum_CS3096      AGACTGGTATCATCAAGCCCCGGTATGGTCGTTACCCTTCGCCTCCCTTCCAAC 849
AF-3_KC691533.1                  GCGC--GCATCATCA-------CGTGATTG-------ACC 447
AF-3_KC691536.1                  GCGC--GCATCATCA-------CGTGATTG-------ACC 447
Fusarium_spp._Strain_EI          A-GT--GCGTCGTCA-------CGTG-TCA-------A-- 411
                                       *     * * *                 *     *

F._oxysporum_f._sp._lycopersic   GTCACCACTGAAGTCAAGTCCGTCGAGATGCACCCACGAGCAGCTCACTGA 845
F._oxysporum_MPI-SDFR-AT-0094_   GTCACCACTGAAGTCAAGTCCGTCGAGATGCACCCACGAGCAGCTCACTGA 899
F._fujikuroi_IMI_58289           GTCACCACTGAAGTCAAGTCCGTCGAGATGCACCCACGAGCAGCTCTCTGA 899
F._solani_FSSC_5                 GTCACCACTGAAGTCAAGTCCGTCGAGATGCACCCACGAGCAGCTCACTGA 899
F._commune_MPI-SDFR-AT-0072      GTCACCACTGAAGTCAAGTCCGTCGAGATGCACCCACGAGCAGCTCACTGA 899
F._verticillioides_7600          GTCACCACTGAAGTCAAGTCCGTCGAGATGCACCCACGAGCAGCTCACTGA 899
F._graminearum_FGSG_08811T0      GTCACCACTGAAGTCAAGTCCGTTGAGATGCACCCACGAGCAGCTCACTGA 899
F._pseudograminearum_CS3096      GTCACCACTGAAGTCAAGTCCGTTGAGATGCACCCACGAGCAGCTCACTGA 899
AF-3_KC691533.1                  ACAAACGCT--AACCGACTCG-------ACAACAGGAAGC-CGCTGA 484
AF-3_KC691536.1                  ACAAACGCT--AACCGACTCG-------ACAACAGGAAGC-CGCTGA 484
Fusarium_spp._Strain_EI          GCAGTCACT--AACCGATTCA-------ACCAATAGGAGC-CGCTGA 447
                                     * *   *   *   *   *     * *   *   * * *   *   * * * *

F._oxysporum_f._sp._lycopersic   GGGCCAGCCCCGGGTGACAACGTTGGTTTCCAACGTGAAGAACGTCTCCGTCA 895
F._oxysporum_MPI-SDFR-AT-0094_   GGGCCAGCCCCGGGTGACAACGTTGGTTTCCAACGTGAAGAACGTCTCCGTCA 949
F._fujikuroi_IMI_58289           GGGCCAGCCCCGGGTGACAACGTTGGTTTCCAACGTGAAGAACGTCTCCGTCA 949
F._solani_FSSC_5                 GGGTCTTCCCGGGTGACAACGTCGGCTTCCAACGTGAAGAACGTCTCCGTCA 949
F._commune_MPI-SDFR-AT-0072      GGGCCAGCCCGGGTGACAACGTTGGTTTCCAACGTGAAGAACGTCTCTGTCA 949
F._verticillioides_7600          GGGCCAGCCCGGGTGACAACGTTGGCTTCCAACGTGAAGAACGTCTCCGTCA 949
F._graminearum_FGSG_08811T0      GGGACAGCCCGGGTGACAACGTTGGTTTCCAACGTGAAGAACGTTCCCGTCA 949
F._pseudograminearum_CS3096      GGGCCAGCCCGGGTGACAACGTTGGTTTCCAACGTGAAGAACGTTCCCGTCA 949
AF-3_KC691533.1                  G-----CTCGGGT----------AAGGGGTTCCCTTCA 504
AF-3_KC691536.1                  G-----CTCGGGT----------AAGGGGTTCCCTTCA 504
Fusarium_spp._Strain_EI          G-----CTCGGGT----------AAGGGGTTCCCTTCA 467
                                 *     *   * * *                 * *   * * *
```

```
F._oxysporum_f._sp._lycopersic   AGGACATCCGACGTGGTAACGTCGCTGGTGACTCCAAGAACGACCCCCCCT 945
F._oxysporum_MPI-SDFR-AT-0094_   AGGACATCCGACGTGGTAACGTCGCTGGTGACTCCAAGAACGACCCCCCT 999
F._fujikuroi_IMI_58289           AGGACATCCGACGTGGTAACGTCGCTGGTGACTCCAAGAACGACCCCCCC 999
F._solani_FSSC_5                 AGGAGATCCGACGTGGCAACGTCGCTGGTGACTCCAAGAACGACCCCCCT 999
F._commune_MPI-SDFR-AT-0072      AGGACATCCGACGTGGTAACGTCGCTGGTGACTCCAAGAACGACCCCCCT 999
F._verticillioides_7600          AGGACATCCGACGTGGTAACGTCGCTGGTGACTCCAAGAACGACCCCCCC 999
F._graminearum_FGSG_08811T0      AGGACATCCGACGTGGTAACGTCGCTGGTGACTCCAAGAACGACCCCCCC 999
F._pseudograminearum_CS3096      AGGACATCCGACGTGGTAACGTCGCTGGTGACTCCAAGAACGACCCCCCC 999
AF-3_KC691533.1                  AGTACGCCTTGG-------------GTCCTTGACAAGCTCAAGGCCGAGC-----  540
AF-3_KC691536.1                  AGTACGCCTTGG-------------GTCCTTGACAAGCTCAAGGCCGAGC-----  540
Fusarium_spp._Strain_EI          AGTACGCCTTGG-------------GTTCTTGACAAGCTCAAGGCCGAGC-----  503
                                 *  *  *  *  *                *  *  *  *  *  *  *  *  *

F._oxysporum_f._sp._lycopersic   ATGGGTGCCGCTTCTTTTCACCGCTCAGGGTCATCGTCCTTCAACCACCCCGG 995
F._oxysporum_MPI-SDFR-AT-0094_   ATGGGTGCCGCTTCTTTTCACCGCCCAGGGTCATCGTCCTTCAACCACCCCGG 1049
F._fujikuroi_IMI_58289           ATGGGTGCCGCTTCTTTTCACCGCCCAGGGTCATCGTCCTTCAACCACCCCGG 1049
F._solani_FSSC_5                 CTGGGTGCCGCCTTCTTTTCACCGCCCAGGGTCATTGTCCTTCAACCACCCCTG 1049
F._commune_MPI-SDFR-AT-0072      CAGGGTGCCGCTTCTTTTCACCGCCCAGGGTCATCGTCCTTCAACCACCCCGG 1049
F._verticillioides_7600          ATGGGTGCCGCTTCTTTTCACCGCTCAGGGTCATTGTCCTTCAACCACCCCGG 1049
F._graminearum_FGSG_08811T0      ATGGGTGCCGCTTCTTTTCACCGCCCAGGGTCATCGTCCTTCAACCACCCCGG 1049
F._pseudograminearum_CS3096      ATGGGTGCCGCTTCTTTTCACCGCCCCAGGGTCATCGTCCTTCAACCACCCCGG 1049
AF-3_KC691533.1                  GTGAGCGT-------------------------GGGT-------------ATCACCC----  557
AF-3_KC691536.1                  GTGAGCGT-------------------------GGGT-------------ATCACCC----  557
Fusarium_spp._Strain_EI          GTGAGCGT-------------------------GGGT-------------ATCACCC----  520
                                    *  *                             *  *  *              *  *  *  *

F._oxysporum_f._sp._lycopersic   TCAGGTCGGTGCTGGTTACGCCTCCCCGTCCTCGATTGCCCACCTGCCCACA 1045
F._oxysporum_MPI-SDFR-AT-0094_   TCAGGTCGGTGCTGGTTACGCCTCCCCGTCCTCGATTGCCCACCTGCCCACA 1099
F._fujikuroi_IMI_58289           TCAGGTCGGTGCTGGTTACGCCTCCCCGTCCTCGATTGCCCACCTGCCCACA 1099
F._solani_FSSC_5                 CCAGGTCGGTGCCGGTTACGCCCCCCCGTTCTTGGACTGCCCACCTGCCCACA 1099
F._commune_MPI-SDFR-AT-0072      TCAGGTCGGTGCTGGTTACGCCTCCCCGTCCTCGATTGCCCACCTGCCCACA 1099
F._verticillioides_7600          TCAGGTCGGTGCTGGTTACGCCTCCCCGTCCTCGATTGCCCACCTGCCCACA 1099
F._graminearum_FGSG_08811T0      TCAGGTCGGTGCTGGTTACGCCTCCCCGTCCTCGATTGCCCACCTGCCCACA 1099
F._pseudograminearum_CS3096      TCAGGTCGGTGCTGGTTACGCCTCCCCGTCCTCGATTGCCCACCTGCCCACA 1099
AF-3_KC691533.1                  ----ATCG-------------------------------------ACATTGCCC----  570
AF-3_KC691536.1                  ----ATCG-------------------------------------ACATTGCCC----  570
Fusarium_spp._Strain_EI          ----ATCG-------------------------------------ATATGCTC----  533
                                     *  *                                       *  *  *  *

F._oxysporum_f._sp._lycopersic   TTGCCTGCAAGTTCGCCGAGATCCAGGGAGAAGATCGACCGCCGAACCGGGT 1095
F._oxysporum_MPI-SDFR-AT-0094_   TTGCCTGCAAGTTCGCCGAGATCCAGGGAGAAGATCGACCGCCGAACCGGGT 1149
F._fujikuroi_IMI_58289           TTGCCTGCAAGTTCGCCGAGATCCAGGGAGAAGATCGACCGCCGAACCGGGT 1149
F._solani_FSSC_5                 TTGCCTGCAAGTTCGCCGAGATCCAGGGAGAAGATCGACCGCCGAACCTGGT 1149
F._commune_MPI-SDFR-AT-0072      TTGCCTGCAAGTTCGCCGAGATCCAGGGAGAAGATCGACCGCCGAACCGGGT 1149
F._verticillioides_7600          TTGCCTGCAAGTTCGCCGAGATCCAGGGAGAAGATCGACCGCCGAACCGGGT 1149
F._graminearum_FGSG_08811T0      TTGCCTGCAAGTTCGCCGAGATCCAGGGAGAAGATCGACCGCCGAACCGGGT 1149
F._pseudograminearum_CS3096      TTGCCTGCAAGTTCGCTGAGATCCAGGGAGAAGATCGACCGCCGAACCGGGT 1149
AF-3_KC691533.1                  ---TCTGGAAGTTCG-------------------------------------  582
AF-3_KC691536.1                  ---TCTGGAAGTTCG-------------------------------------  582
Fusarium_spp._Strain_EI          ---TCTGGAAGTTCG-------------------------------------  545
                                     *  *  *  *  *  *  *

F._oxysporum_f._sp._lycopersic   AAGGCTACTGAGGCCGCCCCCCAAGTTCATCAAGTCTGGGTGACTCCGCCAT 1145
F._oxysporum_MPI-SDFR-AT-0094_   AAGGCTACTGAGGCCGCTCCCCAAGTTCATCAAGTCTGGGTGACTCCGCCAT 1199
F._fujikuroi_IMI_58289           AAGGCTACTGAGGCCGCCCCCCAAGTTCATCAAGTCTGGGTGACTCCGCCAT 1199
F._solani_FSSC_5                 AAGGCTGTTGAGTCCGCCCCCCAAGTTCATCAAGTCTGGGTGACTCCGCCAT 1199
F._commune_MPI-SDFR-AT-0072      AAGGCTACTGAGGCCGCCCCCCAAGTTCATCAAGTCCGGGTGACTCCGCCAT 1199
F._verticillioides_7600          AAGGCTACTGAGTCCGCCCCCTAAGTTCATCAAGTCTGGGTGACTCTGCCAT 1199
F._graminearum_FGSG_08811T0      AAGGCTACTGAGGCCGCCCCCCAAGTTCATCAAGTCTGGGTGACTCCGCCAT 1199
F._pseudograminearum_CS3096      AAGGCTACTGAGGCCGCCCCCCAAGTTCATCAAGTCTGGGTGACTCCGCCAT 1199
AF-3_KC691533.1                  -AGACTCCC-----CGCT-------------------------ACTATGTCAC 604
AF-3_KC691536.1                  -AGACTCCC-----CGCT-------------------------ACTATGTCAC 604
Fusarium_spp._Strain_EI          -AGACTCCT-----CGCT-------------------------ACTATGTCAC 567
                                    *  *  *        *  *  *                       *  *  *  *

F._oxysporum_f._sp._lycopersic   CGTCAAGATGGTTCCCTCCAAGCCCATGTGTGTTGAGGCTTTCACTGACT 1195
F._oxysporum_MPI-SDFR-AT-0094_   CGTCAAGATGGTTCCCTCCAAGCCCATGTGTGTTGAGGCTTTCACTGACT 1249
F._fujikuroi_IMI_58289           CGTCAAGATGGTTCCCTCCAAGCCCATGTGTGTCGAGGCTTTCACTGACT 1249
F._solani_FSSC_5                 CGTCAAGATGGTTCCCTCCAAGCCCATGTGCGTTGAGGCTTTCACTGACT 1249
F._commune_MPI-SDFR-AT-0072      CGTCAAGATGGTTCCCTCCAAGCCCATGTGTGTTGAGGCTTTCACTGACT 1249
F._verticillioides_7600          CGTCAAGATGATTCCCTCCAAGCCCATGTGTGTTGAGGCTTTCACTGACT 1249
F._graminearum_FGSG_08811T0      CGTCAAGATGGTTCCCTCCAAGCCCATGTGTGTTGAGGCTTTCACCCGACT 1249
F._pseudograminearum_CS3096      CGTCAAGATGGTTCCCTCCAAGCCCATGTGTGTTGAGGCTTTCACTGACT 1249
AF-3_KC691533.1                  CGTCAT--TGGT-------------------ATGT-CGCTG-----TCC-----T 627
AF-3_KC691536.1                  CGTCAT--TGGT-------------------ATGT-CGCTG-----TCC-----T 627
Fusarium_spp._Strain_EI          CGTCAT--TGGT-------------------ATGT-TGTCG-----CTCA----T 591
                                 *  *  *  *  *                    *  *  *  *     *     *  *
```

```
F._oxysporum_f._sp._lycopersic      A C C C T C C T C T G G G T C G T T T C G C C G T C C G T G A C A T G C G A C A G A C T G T C G C C 1245
F._oxysporum_MPI-SDFR-AT-0094_      A C C C T C C T C T G G G T C G T T T C G C C G T C C G T G A C A T G C G A C A G A C T G T C G C C 1299
F._fujikuroi_IMI_58289              A C C C T C C T C T G G G T C G T T T C G C C G T C C G T G A C A T G C G A C A G A C T G T C G C C 1299
F._solani_FSSC_5                    A C C C C C C T C T G G G C C G T T T C G C C G T C C G T G A C A T G C G A C A G A C C G T T G C T 1299
F._commune_MPI-SDFR-AT-0072         A C C C T C C T C T G G G T C G T T T C G C C G T C C G T G A C A T G C G A C A G A C T G T C G C C 1299
F._verticillioides_7600             A C C C T C C T C T G G G T C G T T T C G C C G T C C G T G A C A T G C G A C A G A C C G T C G C C 1299
F._graminearum_FGSG_08811T0         A C C C T C C T C T G G G T C G T T T C G C C G T C C G T G A C A T G C G A C A G A C C G T C G C C 1299
F._pseudograminearum_CS3096         A C C C T C C T C T G G G T C G T T T C G C C G T C C G T G A C A T G C G A C A G A C C G T C G C C 1299
AF-3_KC691533.1                     C T C T C A A T C - A - - - T G T C T C G C C - - A C - T A A C A - A T - - C A A - C A G A C G C C 666
AF-3_KC691536.1                     C T C T C A A T C - A - - - T G T C T C G C C - - A C - T A A C A - A T - - C A A - C A G A C G C C 666
Fusarium_spp._Strain_EI             G C T T C A T T C T A - - - C T T C T C T T C G T A C - T A A C A T A T - - C A C T C A G A C G C T 635
                                                  * *             * * *           *           *   *   * * *               * *     *   *       * *

F._oxysporum_f._sp._lycopersic      G T T G G T G T C A T C A A G G C T G T C G A G A A G T C C A G C G G T G C T G C C G G C A A G G T 1295
F._oxysporum_MPI-SDFR-AT-0094_      G T T G G T G T C A T C A A G G C C G T C G A G A A G T C C A G C G G T G C T G C C G G C A A G G T 1349
F._fujikuroi_IMI_58289              G T C G G T G T C A T C A A G G C C G T C G A G A A G T C C A C T G G T G C T G C C G G C A A G G T 1349
F._solani_FSSC_5                    G T C G G T G T C A T C A A G G C C G T C G A G A A G G C T G C T G C T G G C T C C G G C A A G G T 1349
F._commune_MPI-SDFR-AT-0072         G T C G G T G T C A T C A A G G C C G T C G A G A A G T C C G C T G G T G G T T C C G G C A A G G T 1349
F._verticillioides_7600             G T C G G T G T C A T C A A G G C C G T C G A G A A G T C C T C T G G T G C T G C C G G C A A G G T 1349
F._graminearum_FGSG_08811T0         G T C G G T G T C A T C A A G G C C G T C G A G A A G T C C A C T G G C G C T G C T G G C A A G G T 1349
F._pseudograminearum_CS3096         G T C G G T G T C A T C A A G G C C G T C G A G A A G T C C A C T G G C G C T G C T G G C A A G G T 1349
AF-3_KC691533.1                     C C C G G - - C C A C C - - - - - - - - - - - - - - - - - - - - - - G - - - - - - - - - - - - - - 677
AF-3_KC691536.1                     C C C G G - - C C A C C - - - - - - - - - - - - - - - - - - - - - - G - - - - - - - - - - - - - - 677
Fusarium_spp._Strain_EI             C C C G G - - T C A C C - - - - - - - - - - - - - - - - - - - - - - G T G A T T T C A T C A A G A A 661
                                      * *           * *   *

F._oxysporum_f._sp._lycopersic      C A C C A A G T C C G C T G C C A A G G C C G C C A A G A A A T - -                                 1327
F._oxysporum_MPI-SDFR-AT-0094_      C A C C A A G T C C G C T G C C A A G G C C G C C A A G A A A T A A                                 1383
F._fujikuroi_IMI_58289              C A C C A A G T C C G C T G C C A A G G C C G C C A A G A A A T A A                                 1383
F._solani_FSSC_5                    C A C C A A G T C C G C T G C C A A G G C T G C C A A G A A A G T A A                                 1383
F._commune_MPI-SDFR-AT-0072         C A C C A A G T C C G C T G C C A A G G C C G C C A A G A A A T A A                                 1383
F._verticillioides_7600             C A C C A A G T C C G C T G C C A A G G C C G C T A A G A A A T - -                                 1381
F._graminearum_FGSG_08811T0         C A C C A A G T C C G C T G C C A A G G C T G G T A A G A A A - - -                                 1380
F._pseudograminearum_CS3096         C A C C A A G T C C G C T G C C A A G G C T G G T A A G A A A T A A                                 1383
AF-3_KC691533.1                     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
AF-3_KC691536.1                     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Fusarium_spp._Strain_EI             C A T G A C T T G G G G T - - - - A A T C C C C C A - - - - - - - -                                 683
```

Figure S3. Amino acid sequence alignment of GH12 enzymes.

Amino acid sequences of GH12 members were aligned using ClustalW. Identical amino acids are highlighted. Dots and colons indicate conserved amino acids with substitutions. Dashes indicate gaps. The 25-kDa protein (LC634256) from *Fusarium* spp. strain EI, CVL13720.1 from *F. proliferatum*, XP_018760412.1 from *F. verticillioides* 7600, XP_011325323.1 from *F. graminearum* PH-1, OXN20159.1 from *Aspergillus fumigatus*, and GAM41656.1 from *Talaromyces cellulolyticus* are shown. The putative active site is highlighted in yellow.