Supplemental Materials

Endophytic actinomycetes from tea plants (*Camellia sinensis*): Isolation, abundance, antimicrobial and plant growth-promoting activities

Wenna Shan[1,2]#, Ying Zhou[2,3]#, Huihui Liu[1,2], Xiaomin Yu[2]*

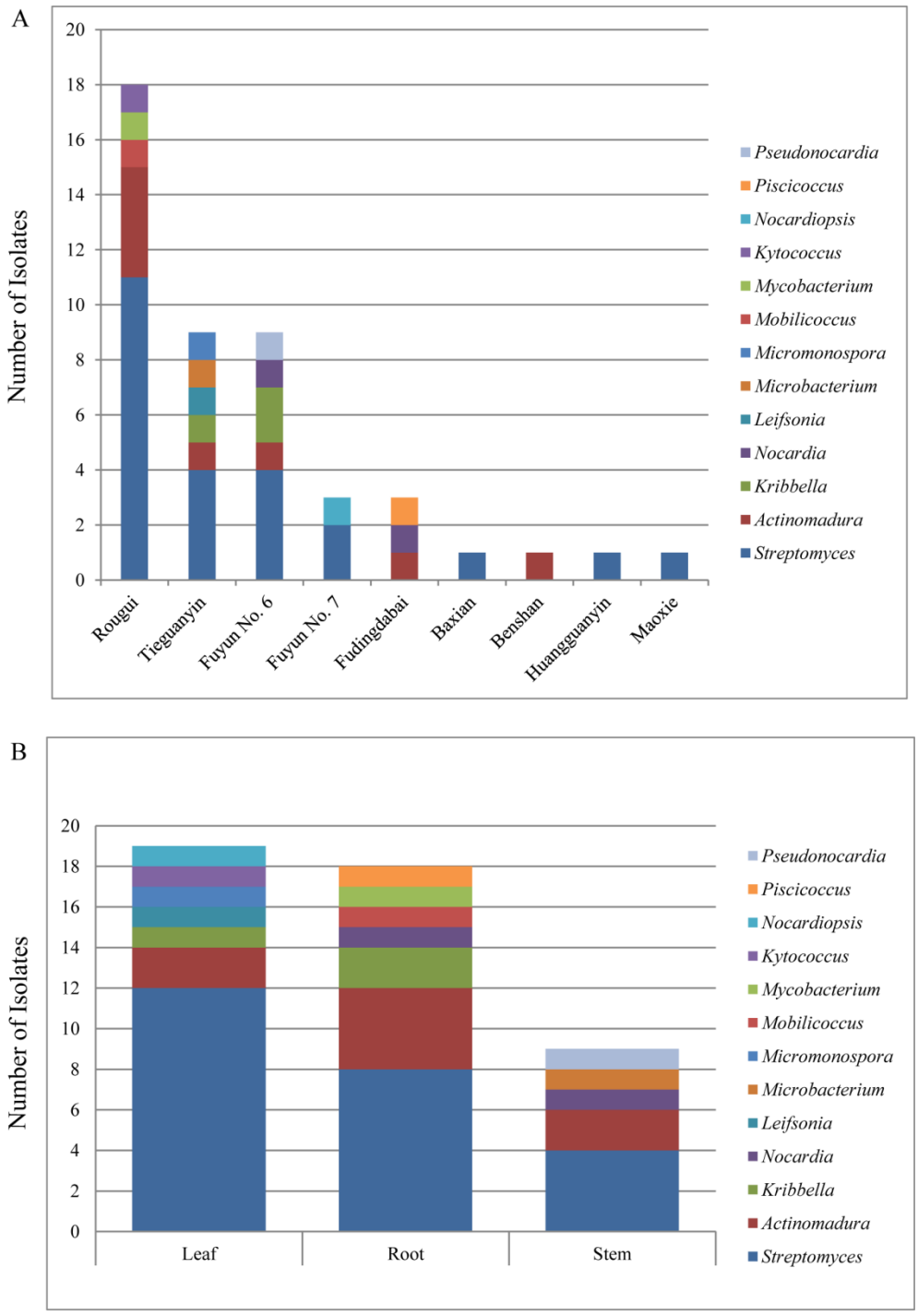
1. College of Horticulture, Fujian Agriculture and Forestry University, Fuzhou 350002, China
2. FAFU-UCR Joint Center for Horticultural Biology and Metabolomics, Fujian Provincial Key Laboratory of Haixia Applied Plant Systems Biology, Fujian Agriculture and Forestry University, Fuzhou 350002, China
3. College of Life Sciences, Fujian Agriculture and Forestry University, Fuzhou 350002, China

# S.W. and Z.Y. contributed equally to this work.

*__Correspondence:__

Dr. Xiaomin Yu

xmyu0616@fafu.edu.cn



Supplemental Figure S1. Abundance and diversity of culturable endophytic actinomycetes from tea plants. (**A**) Abundance and diversity of actinomycete isolates among different tea cultivars. (**B**) Abundance and diversity of actinomycete isolates among different tea plant tissues.

28 **Supplemental Table S1. 16S rRNA sequence similarity with type strains**

Strain Name	Accession No.	Top-hit strain	Similarity (%)
XY006	MF496983	*Streptomyces levis* NBRC 15423(T)	100.00
XY025	MH432655	*Kytococcus schroeteri* DSM 13884(T)	99.86
XY041	MH432650	*Leifsonia lichenia* 2Sb(T)	100.00
XY042	MH432656	*Streptomyces rhizophilus* JR-41(T)	99.72
XY049	MH432651	*Kribbella karoonensis* Q41(T)	99.52
XY051	MH432657	*Microbacterium testaceum* DSM 20166(T)	99.65
XY065	MH432658	*Streptomyces gilvifuscus* T113(T)	98.33
XY111	MH432665	*Streptomyces xiamenensis* MCCC 1A01550(T)	99.38
XY112	MH432660	*Streptomyces gilvifuscus* T113(T)	98.05
XY133	MH432666	*Micromonospora olivasterospora* DSM 43868(T)	99.10
XY134	MH432663	*Actinomadura geliboluensis* A8036(T)	98.75
XY135	MH432652	*Mycobacterium fortuitum* JCM 6368(T)	99.93
XY138	MH432670	*Actinomadura meyerae* DSM 44715(T)	99.10
XY139	MH432661	*Actinomadura meyerae* DSM 44715(T)	98.82
XY140	MH432662	*Actinomadura bangladeshensis* 3-46-b3(T)	99.17
XY141	MH432664	*Actinomadura geliboluensis* A8036(T)	98.75
XY142	MH432653	*Nocardia jiangxiensis* NBRC 101359(T)	98.96
XY144	MH432659	*Mobilicoccus caccae* YIM 101593(T)	99.72
XY145	MH432654	*Piscicoccus intestinalis* NBRC 104926(T)	99.86
XY172	MH432669	*Kribbella shirazensis* UTMC 693(T)	99.29
XY173	MH432690	*Streptomyces griseoaurantiacus* NBRC 15440(T)	100.00
XY174	MH432671	*Kribbella shirazensis* UTMC 693(T)	99.07
XY186	MH432688	*Streptomyces fumigatiscleroticus* NBRC 12999(T)	99.17
XY188	MH432683	*Streptomyces diastaticus* NRRL B-1773(T)	99.72
XY189	MH432684	*Streptomyces gilvifuscus* T113(T)	98.26
XY190	MH432689	*Streptomyces thermocarboxydus* DSM 44293(T)	99.79
XY191	MH432668	*Streptomyces fumigatiscleroticus* NBRC 12999(T)	99.24
XY192	MH432685	*Streptomyces costaricanus* NBRC 100773(T)	99.79
XY199	MH432694	*Nocardia jiangxiensis* NBRC 101359(T)	99.03
XY205	MH432667	*Streptomyces gilvifuscus* T113(T)	98.33
XY207	MH432672	*Streptomyces griseorubiginosus* DSM 40469(T)	99.79
XY208	MH432673	*Streptomyces djakartensis* NBRC 15409(T)	98.19
XY209	MH432674	*Streptomyces griseoaurantiacus* NBRC 15440(T)	98.69

XY220	MH432686	*Streptomyces griseorubiginosus* DSM 40469(T)	99.79
XY223	MH432687	*Streptomyces griseoaurantiacus* NBRC 15440(T)	98.75
XY224	MH432676	*Streptomyces fumigatiscleroticus* NBRC 12999(T)	98.75
XY225	MH432679	*Streptomyces griseoaurantiacus* NBRC 15440(T)	98.82
XY227	MH432691	*Actinomadura geliboluensis* A8036(T)	98.96
XY229	MH432680	*Actinomadura nitritigenes* DSM 44137(T)	99.30
XY230	MH432675	*Streptomyces gilvifuscus* T113(T)	97.64
XY231	MH432677	*Streptomyces longispororuber* NBRC 13488(T)	99.51
XY232	MH432681	*Actinomadura nitritigenes* DSM 44137(T)	99.23
XY233	MH432678	*Streptomyces griseoaurantiacus* NBRC 15440(T)	98.75
XY234	MH432692	*Pseudonocardia kunmingensis* YIM 63158(T)	99.35
XY235	MH432682	*Streptomyces griseoaurantiacus* NBRC 15440(T)	99.79
XY236	MH432693	*Nocardiopsis dassonvillei* NBRC 13392(T)	99.86

29

30

Supplemental Table S2. Biosynthetic genes (PKS-I, PKS-II and NRPS) and antibacterial activities of culturable endophytic actinomycetes from tea plants

Isolate no.	Antibacterial activities (zone of inhibition in mm)[a]				Biosynthetic genes[b]		
	P. aeruginosa	*S. aureus*	*E. coli*	*B. subtilis*	PKS-I	PKS-II	NRPS
XY006	-	-	-	-	+	-	+
XY025	ND	ND	ND	ND	-	-	-
XY041	ND	ND	ND	ND	-	-	-
XY042	-	-	-	-	+	+	+
XY049	ND	ND	ND	ND	-	-	-
XY051	ND	ND	ND	ND	-	-	-
XY065	-	-	-	-	-	+	-
XY111	-	-	-	-	-	+	+
XY112	-	-	-	-	-	+	+
XY133	-	-	-	-	-	+	+
XY134	-	-	-	++ (8.7±0.6)	+	-	+
XY135	-	-	-	-	+	-	+
XY138	-	-	-	-	+	-	+
XY139	-	-	-	-	+	-	+
XY140	-	-	-	++ (9.3±0.6)	+	-	+
XY141	-	-	-	-	-	-	+
XY142	-	-	-	-	+	-	+
XY144	ND	ND	ND	ND	-	-	-
XY145	-	-	-	-	-	-	+
XY172	ND	ND	ND	ND	-	-	-
XY173	-	-	-	-	+	+	-
XY174	ND	ND	ND	ND	-	-	-
XY186	ND	ND	ND	ND	-	-	-
XY188	-	-	-	-	+	+	+
XY189	-	-	-	-	+	+	-
XY190	-	-	-	-	+	+	-
XY191	-	+++ (14.0±0.6)	-	+++ (14.0±1.0)	+	+	+
XY192	-	+++ (19.3±0.6)	-	+++ (19.0±1.0)	+	+	+
XY199	-	-	-	-	+	-	+
XY205	ND	ND	ND	ND	-	-	-
XY207	-	-	-	-	+	+	+
XY208	-	+++ (12.7±0.6)	-	+++ (12.0±1.0)	+	+	+
XY209	-	-	-	-	+	+	+
XY220	-	-	-	-	-	+	+
XY223	-	-	-	++ (7.7±0.6)	+	+	+
XY224	-	-	-	++ (9.7±0.6)	+	+	+
XY225	-	-	-	-	+	+	+

XY227	-	++ (8.7 ±1.2)	-	+++ (11.0 ±1.0)	+	-	+
XY229	-	++ (9.3 ±0.6)	-	-	+	+	+
XY230	-	-	-	-	-	+	+
XY231	-	-	-	-	+	+	+
XY232	-	-	-	+++ (11.0 ±1.0)	+	+	+
XY233	-	-	-	-	+	+	+
XY234	-	-	-	++ (8.7 ±0.6)	-	-	+
XY235	-	-	-	-	+	+	+
XY236	-	-	-	-	+	+	-

[a] Determined by measuring the size of inhibition zone. Symbols: -, no activity; +, weak activity, inhibition zone between 0-4.9 mm; ++, moderate activity, inhibition zone between 5.0-9.9 mm; +++, strong activity, inhibition zone >10 mm. ND, not determined. Experiments were performed in triplicates. Numbers in the parenthesis indicate the size of inhibition zone in mm, which are expressed as mean ± SD.

[b] +, present; -, absent.

Supplemental Table S3. Antifungal activities of culturable endophytic actinomycetes from tea plants

Isolate no.	Antifungal activities (GI%)[a]								
	M. oryzae	*F. graminearum*	*F. oxysporum* f. sp *lycopersici*	*F. oxysporum* f. sp *cubense*	*F. verticillioides*	*Colletotrichum* sp.	*Pestalotiopsis* sp.	*Diaporthe* sp.	*Xylaria* sp.
XY006	50.0	45.5	50.0	40.0	43.8	50.3	-	-	33.3
XY065	-	-	-	-	-	-	-	46.0	-
XY133	-	-	-	40.0	37.5	-	-	-	16.7
XY134	40.0	-	-	-	-	-	-	-	-
XY208	-	-	-	-	-	-	32.0	30.4	-
XY235	-	-	-	-	21.4	-	-	-	-
XY236	-	-	-	-	-	-	-	30.4	-

[a] Determined by measuring the growth inhibition percentage (GI%), which is calculated as [1-(diameter of mycelial growth in the direction of crude extracts/diameter of mycelial growth in the direction of negative control)] ×100%. -, no activity. Only actinomycete isolates showing positive antifungal activities against any of the test fungi are included in the table.

Supplemental Table S4. IAA production and ACC deaminase activity of endophytic actinomycetes from tea plants

Isolate	IAA (μg/mL)[a]	ACCD[b]
XY006	12.7±0.5	+
XY025	7.2±2.0	-
XY041	4.9±0.3	-
XY042	7.4±2.5	-
XY049	4.2±0.1	-
XY051	43.1±8.7	-
XY065	4.3±0.7	+
XY111	4.7±0.1	-
XY112	6.1±0.2	-
XY133	ND	-
XY134	9.5±3.5	-
XY135	11.7±0.3	-
XY138	8.6±2.0	-
XY139	8±0.4	-
XY140	6.6±0.2	-
XY141	5.9±1.0	-
XY142	2.2±0.1	-
XY144	8.8±0.3	-
XY145	18.7±3.3	-
XY172	7.4±0.6	-
XY173	6.2±0.1	-
XY174	6.3±0.3	-
XY186	ND	+
XY188	4.5±0.2	+
XY189	4.3±0.2	-
XY190	5.4±0.4	-
XY191	4.7±0.2	-
XY192	8.1±0.2	-
XY199	4.8±0.1	-
XY205	ND	+
XY207	9.9±0.5	+
XY208	7.7±2.0	-
XY209	5.1±0.3	-
XY220	12.4±0.7	+
XY223	9.4±0.8	-
XY224	7.2±0.4	-
XY225	5.7±0.3	-
XY227	6.6±0.1	-

XY229	4.9±0.0	-
XY230	5.4±0.4	+
XY231	5.2±1.4	+
XY232	3.4±0.4	-
XY233	5.2±0.1	-
XY234	5.5±0.0	-
XY235	11.7±0.2	-
XY236	5.4±0.2	+

[a] IAA was quantified after growing strains in LB broth in the presence of 5 mM tryptophan. ND, not detected.

[b] ACCD, ACC deaminase; +, present; -, absent.