

Supplementary Table 1. Characteristics of *Erwinia amylovora* isolates collected from Korea in this study

Sample	Province	City	Township	Host	Isolate number	Isolation date
117Z	Gyeonggi	Anseong	Seoun-myeon	Pear	1	20.6.17
H96			Yangseong-myeon	Apple	1	21.6.11
H97			Seoun-myeon	Pear	2	21.6.11
H98			Seoun-myeon	Apple	2	21.6.11
H150			Geumgwang-myeon	Apple	2	21.6.16
H151			Samjuk-myeon	Apple	2	21.6.16
H152			Iljuk-myeon	Apple	2	21.6.16
H153			Seoun-myeon	Pear	2	21.6.16
H154			Seoun-myeon	Apple	2	21.6.16
H166			Geumgwang-myeon	Apple	2	21.6.16
H167			Geumgwang-myeon	Apple	2	21.6.16
H168			Geumgwang-myeon	Apple	2	21.6.16
H169			Miyang-myeon	Apple	2	21.6.16
H239			Jungni-dong	Pear	1	21.6.28
91B			Bogae-myeon	Pear	2	21.7.17
91C			Miyang-myeon	Pear	2	21.7.17
91E			Miyang-myeon	Pear	2	21.7.17
99P			Gye-dong	Apple	2	21.7.26
99Q			Yangseong-myeon	Pear	2	21.7.26
107D			Yangseong-myeon	Pear	2	21.7.29
110LB			Seoun-myeon	Pear	2	21.8.10
113R			Geumgwang-myeon	Apple	2	21.8.10
116VB			Seoun-myeon	Hawthorn	2	21.8.23
117WA			Miyang-myeon	Pear	2	21.10.27
118Z			Seoun-myeon	Pear	2	21.10.27
118A			Seoun-myeon	Pear	2	21.10.27
118B			Seoun-myeon	Pear	2	21.10.27
121I			Seoun-myeon	Pear	2	21.10.27
121K			Miyang-myeon	Pear	2	21.10.27
121L			Seoun-myeon	Pear	2	21.10.27
123Q			Seoun-myeon	Pear	2	21.10.29
123R			Daedeok-myeon	Pear	2	21.10.29
123S			Seoun-myeon	Pear	2	21.10.29
125Z			Yangseong-myeon	Pear	2	21.11.1
125A			Seoun-myeon	Pear	2	21.11.1
125B			Seoun-myeon	Pear	2	21.11.1
125C			Seoun-myeon	Pear	2	21.11.1
125D			Miyang-myeon	Pear	1	21.11.1
125E			Miyang-myeon	Pear	2	21.11.1
129K			Sinsohyeon-dong	Pear	2	21.11.5
129L			Seoun-myeon	Pear	2	21.11.5
129M			Yangseong-myeon	Pear	2	21.11.5
129N			Yangseong-myeon	Pear	2	21.11.8
129O			Miyang-myeon	Pear	2	21.11.8
132T			Jungni-dong	Pear	2	21.11.8
132V			Seoun-myeon	Pear	2	21.11.8
132W			Miyang-myeon	Pear	2	21.11.8
132X			Seoun-myeon	Pear	2	21.11.8
132Y			Seoun-myeon	Pear	2	21.11.8

135C			Seoun-myeon	Pear	2	21.11.12
135D			Bogae-myeon	Pear	2	21.11.12
138N			Seoun-myeon	Pear	2	21.11.15
138O			Seoun-myeon	Pear	2	21.11.15
140R			Seoun-myeon	Pear	2	21.11.19
140S			Seoun-myeon	Pear	2	21.11.19
140T			Miyang-myeon	Pear	2	21.11.19
140V			Daedeok-myeon	Pear	2	21.11.19
140W			Seoun-myeon	Pear	2	21.11.19
140X			Seoun-myeon	Pear	2	21.11.19
H11			Jungni-dong	Apple	2	21.6.6
H12			Daedeok-myeon	Pear	2	21.6.6
H14			Seoun-myeon	Pear	2	21.6.6
H17			Seoun-myeon	Pear	2	21.6.6
H18			Seoun-myeon	Pear	2	21.6.6
H44			Seoun-myeon	Pear	2	21.6.6
H45			Daedeok-myeon	Pear	2	21.6.6
H55			Bogae-myeon	Apple	2	21.6.6
H56			Seoun-myeon	Pear	1	21.6.6
H96			Yangseong-myeon	Apple	1	21.6.11
Subtotal			69		132	
19K	Gyeonggi	Namyangju	Wabu-eup	Pear	3	21.5.28
20L			Ipae-dong	Pear	2	21.6.4
20M			Wabu-eup	Pear	2	21.6.4
20N			Wabu-eup	Pear	2	21.6.4
20O			Wabu-eup	Apple	2	21.6.4
Subtotal			5		11	
36T	Gyeonggi	Yeoju	Ganam-eup	Apple	2	21.6.14
36V			Ganam-eup	Apple	2	21.6.14
Subtotal			2		4	
129P	Gyeonggi	Icheon	Moga-myeon	Pear	1	20.7.1
18I			Baksa-myeon	Pear	2	21.5.28
27Z			Janghowon-eup	Apple	1	21.6.6
35R			Janghowon-eup	Apple	2	21.6.10
35S			Janghowon-eup	Apple	2	21.6.10
39Y			Janghowon-eup	Apple	2	21.6.14
39Z			Janghowon-eup	Apple	2	21.6.14
54Z			Janghowon-eup	Apple	2	21.7.21
Subtotal			8		14	
137O	Gyeonggi	Gwangju	Namjong-myeon	Apple	1	20.8.6
Subtotal			1		1	
192I	Gyeonggi	Pyeongtak	Jukbaek-dong	Pear	1	20.7.31
94G			Paengseong-eup	Pear	3	21.7.21
94H			Paengseong-eup	Apple	3	21.7.21
97L			Jukbaek-dong	Pear	2	21.7.26
97M			Wolgok-dong	Pear	2	21.7.26
97N			Paengseong-eup	Pear	2	21.7.26
103V			Paengseong-eup	Pear	1	21.7.29
103W			Paengseong-eup	Apple	2	21.7.29
105Z			Paengseong-eup	Pear	2	21.7.29
H15			Wolgok-dong	Pear	2	21.6.6
Subtotal			10		20	

38X	Gangwon	Pyeongchang	Pyeongchang-eup	Apple	2	21.6.14
Subtotal			1		2	
21P	Gangwon	Yeongwol	Nam-myeon	Apple	2	21.6.4
Subtotal			1		2	
37W	Chungbuk	Goesan	Jangyeon-myeon	Apple	2	21.6.14
44I			Chilseong-myeon	Apple	2	21.6.16
Subtotal			2		4	
22Q	Chungbuk	Danyang	Eosangcheon-myeon	Apple	2	21.6.4
22R			Eosangcheon-myeon	Apple	2	21.6.4
Subtotal			2		4	
70FA	Chungbuk	Emseong	Emseong-eup	Apple	1	20.7.22
H20			Daeso-myeon	Pear	2	21.6.6
H80			Geumwang-eup	Apple	2	21.6.11
H82			Geumwang-eup	Apple	2	21.6.11
H84			Geumwang-eup	Apple	2	21.6.11
H85			Geumwang-eup	Apple	2	21.6.11
H87			Geumwang-eup	Apple	2	21.6.11
H91			Geumwang-eup	Apple	2	21.6.11
H159			Samseong-myeon	Apple	2	21.6.16
H160			Geumwang-eup	Apple	2	21.6.16
H161			Geumwang-eup	Apple	2	21.6.16
H162			Daeso-myeon	Apple	1	21.6.16
H231			Daeso-myeon	Apple	2	21.6.25
H253			Samseong-myeon	Apple	2	21.6.25
H187			Samseong-myeon	Pear	1	21.6.25
H188			Geumwang-eup	Apple	2	21.6.25
H189			Geumwang-eup	Apple	2	21.6.25
H190			Samseong-myeon	Apple	2	21.6.25
H215			Gamgok-myeon	Apple	2	21.6.25
130P			Samseong-myeon	Pear	2	21.11.5
130Q			Daeso-myeon	Pear	2	21.11.5
Subtotal			21		39	
39H	Chungbuk	Jecheon	Baegun-myeon	Apple	1	20.5.29
49O			Baegun-myeon	Apple	1	20.7.8
85L			Bongyang-eup	Apple	1	20.7.27
187C			Sinwol-dong	Apple	1	20.8.13
16G			Baegun-myeon	Apple	1	20.6.5
H4			Baegun-myeon	Apple	2	21.6.6
H6			Baegun-myeon	Apple	2	21.6.6
H88			Baegun-myeon	Apple	2	21.6.11
H89			Baegun-myeon	Apple	2	21.6.11
H90			Baegun-myeon	Apple	2	21.6.11
H109			Baegun-myeon	Apple	2	21.6.16
H170			Baegun-myeon	Apple	2	21.6.16
H171			Baegun-myeon	Apple	2	21.6.16
H172			Baegun-myeon	Apple	2	21.6.16
H175			Baegun-myeon	Apple	2	21.6.16
H176			Baegun-myeon	Apple	2	21.6.16
H191			Baegun-myeon	Apple	2	21.6.16
H118			Baegun-myeon	Apple	2	21.6.18
H258			Baegun-myeon	Apple	2	21.6.25
H218			Baegun-myeon	Apple	2	21.6.25

H192			Baegun-myeon	Apple	2	21.6.25
H216			Cheongpung-myeon	Apple	2	21.6.25
89X			Baegun-myeon	Apple	1	21.7.17
102T			Baegun-myeon	Apple	2	21.7.29
115T			Baegun-myeon	Apple	11	21.8.23
Subtotal			25		53	
15CB	Chungbuk	Chungju	Sancheok-myeon	Apple	1	20.6.5
20Y			Sancheok-myeon	Apple	1	20.6.5
63WA			Sotae-myeon	Apple	1	20.6.5
50A			Dongnyang-myeon	Apple	1	20.7.8
50B			Eomjeong-myeon	Apple	1	20.7.8
H1			Dongnyang-myeon	Apple	2	21.6.6
H2			Sancheok-myeon	Apple	2	21.6.6
H3			Sotae-myeon	Apple	2	21.6.6
H7			Sancheok-myeon	Apple	2	21.6.6
H36			Sancheok-myeon	Apple	2	21.6.6
H37			Eomjeong-myeon	Apple	2	21.6.6
H46			Sancheok-myeon	Apple	2	21.6.6
H47			Sotae-myeon	Apple	2	21.6.6
H48			Sancheok-myeon	Apple	2	21.6.6
H49			Sancheok-myeon	Apple	1	21.6.6
H61			Dongnyang-myeon	Apple	2	21.6.6
H62			Sotae-myeon	Apple	2	21.6.6
H63			Sotae-myeon	Apple	2	21.6.6
H73			Dongnyang-myeon	Apple	1	21.6.11
H76			Sancheok-myeon	Apple	2	21.6.11
H77			Sancheok-myeon	Apple	2	21.6.11
H86			Sotae-myeon	Pear	2	21.6.11
H94			Sancheok-myeon	Apple	2	21.6.11
H95			Sancheok-myeon	Apple	2	21.6.11
H121			Geumga-myeon	Apple	2	21.6.16
H163			Geumga-myeon	Apple	3	21.6.16
H164			Eomjeong-myeon	Apple	1	21.6.16
H165			Sancheok-myeon	Apple	2	21.6.16
H177			Eomjeong-myeon	Apple	2	21.6.16
H178			Sotae-myeon	Apple	2	21.6.16
H179			Geumga-myeon	Apple	2	21.6.16
H180			Eomjeong-myeon	Apple	2	21.6.16
H181			Dongnyang-myeon	Apple	2	21.6.16
H182			Sancheok-myeon	Apple	2	21.6.16
H183			Eomjeong-myeon	Apple	2	21.6.16
H123			Sotae-myeon	Apple	2	21.6.18
H126			Judeok-eup	Apple	2	21.6.18
H127			Eomjeong-myeon	Apple	2	21.6.18
H128			Sotae-myeon	Apple	2	21.6.18
H129			Sotae-myeon	Apple	2	21.6.18
H199			Sancheok-myeon	Apple	2	21.6.25
H204			Dongnyang-myeon	Apple	2	21.6.25
H205			Dongnyang-myeon	Apple	2	21.6.25
H206			Sotae-myeon	Apple	2	21.6.25
H207			Dongnyang-myeon	Apple	2	21.6.25
H209			Eomjeong-myeon	Apple	2	21.6.25

H211			Sotae-myeon	Apple	2	21.6.25
H212			Sancheok-myeon	Apple	4	21.6.25
H213			Sancheok-myeon	Apple	4	21.6.25
H219			Sancheok-myeon	Apple	2	21.6.25
H221			Allim-dong	Apple	2	21.6.25
H224			Sancheok-myeon	Apple	2	21.6.25
H235			Sotae-myeon	Apple	2	21.6.25
H236			Eomjeong-myeon	Apple	2	21.6.25
H251			Judeok-eup	Apple	2	21.6.25
H260			Sotae-myeon	Apple	2	21.6.25
H261			Eomjeong-myeon	Apple	2	21.6.25
92D			Geumga-myeon	Apple	4	21.7.21
101S			Sinni-myeon	Apple	2	21.7.21
Subtotal			59		117	
37D	Chungbuk	Jincheon	Baekgok-myeon	Apple	1	20.6.10
Subtotal			1		1	
23S	Chungnam	Dangjin	Sunseong-myeon	Apple	2	21.6.4
24T			Sunseong-myeon	Apple	2	21.6.6
24V			Sunseong-myeon	Apple	2	21.6.6
26X			Ugang-myeon	Apple	2	21.6.6
26Y			Sunseong-myeon	Apple	2	21.6.6
34O			Ugang-myeon	Apple	2	21.6.10
34P			Ugang-myeon	Apple	2	21.6.10
34Q			Ugang-myeon	Apple	2	21.6.10
40B			Sinpyeong-myeon	Apple	2	21.6.14
Subtotal			9		18	
134D	Chungnam	Asan	Yeongin-myeon	Apple	1	20.8.6
95I			Inju-myeon	Apple	2	21.7.21
98O			Dunpo-myeon	Pear	2	21.7.26
Subtotal			3		5	
H19	Chungnam	Cheonan	Jiksan-eup	Pear	2	21.6.6
H52			Jiksan-eup	Pear	2	21.6.6
H53			Ipjang-myeon	Pear	2	21.6.6
H57			Ipjang-myeon	Pear	2	21.6.6
H59			Ipjang-myeon	Pear	2	21.6.6
90Y			Jiksan-eup	Pear	2	21.7.17
90Z			Seonggeo-eup	Apple	2	21.7.17
90A			Ipjang-myeon	Apple	2	21.7.17
96K			Ipjang-myeon	Apple	2	21.7.26
104X			Seonghwan-eup	Pear	2	21.7.29
104Y			Seonghwan-eup	Pear	2	21.7.29
106C			Cheongdang-dong	Apple	2	21.7.29
108F			Eopseong-dong	Apple	2	21.8.2
109H			Seonghwan-eup	Pear	2	21.8.2
109I			Ipjang-myeon	Quince	2	21.8.2
112P			Seonggeo-eup	Pear	1	21.8.6
112Q			Ipjang-myeon	Pear	2	21.8.6
111N			Seonggeo-eup	Pear	2	21.8.6
111O			Ipjang-myeon	Pear	2	21.8.6
114S			Jiksan-eup	Pear	2	21.8.15
119C			Seonghwan-eup	Pear	1	21.10.27
119D			Seonghwan-eup	Pear	1	21.10.27

119F			Seonghwan-eup	Pear	2	21.10.27
122M			Jiksan-eup	Pear	2	21.10.27
122N			Ipjang-myeon	Pear	3	21.10.27
122O			Ipjang-myeon	Pear	1	21.10.27
122P			Ipjang-myeon	Pear	3	21.10.27
124V			Ipjang-myeon	Pear	2	21.10.29
124W			Jiksan-eup	Pear	2	21.10.29
124X			Ipjang-myeon	Pear	2	21.10.29
124Y			Ipjang-myeon	Pear	2	21.10.29
127G			Jiksan-eup	Pear	3	21.11.1
127H			Seonghwan-eup	Pear	2	21.11.1
131R			Seonghwan-eup	Pear	2	21.11.5
133Z			Seonggeo-eup	Pear	3	21.11.8
133A			Dong-myeon	Pear	2	21.11.8
134B			Jiksan-eup	Pear	2	21.11.10
136G			Jiksan-eup	Pear	3	21.11.12
136H			Ipjang-myeon	Pear	2	21.11.12
136I			Seonghwan-eup	Pear	3	21.11.12
Subtotal			40		82	
41C	Gyeongbuk	Andong	Giran-myeon	Apple	2	21.6.14
43G			Imha-myeon	Apple	1	21.6.16
45J			Iljik-myeon	Apple	1	21.7.21
43H			Imha-myeon	Apple	2	21.7.21
Subtotal			4		6	
26R	Jeonbuk	Iksan	Namsan-myeon	Apple	1	20.6.1
Subtotal			1		1	
Total			264		516	

Supplementary Table 2. Primers for amplification of *gyrA*, *gyrB*, and *parC* target regions in *Erwinia amylovora*

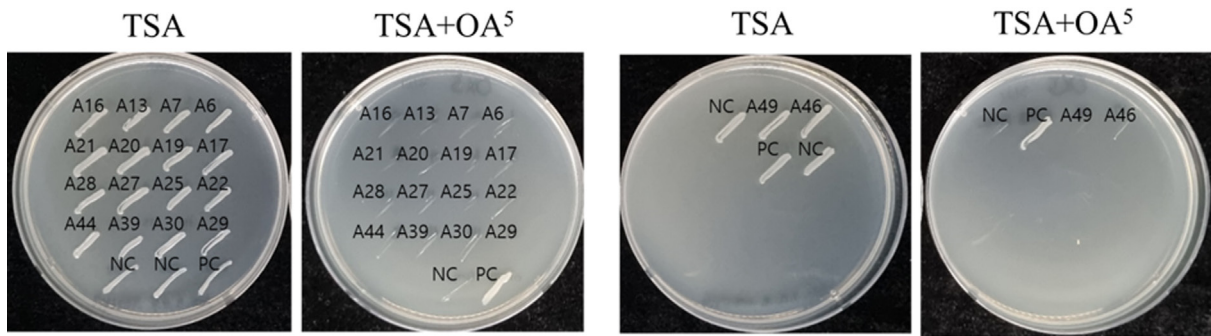
Target gene	Primer name	Oligonucleotide sequence (5'-3')	Annealing temperature (°C)	Amplicon size (bp)
<i>gyrA</i>	EagyrA_F	CAC CGG TCA ATA TCG AAG AAG AGT	58	507
	EagyrA_R	TAC CCA CGG CGA TCC CAG AAG AAC		
<i>gyrB</i>	EagyrB_F	TCG GCG GTT GAG CAG CAG ATG	58	661
	EagyrB_R	GCA GCG TGG CAC CGT CAA GAG		
<i>parC</i>	EaparC1_F	TGC GAT GTC GGA ACT GGG GCT AAG	62	743
	EaparC1_R	TCG GGT TCT CAT GAT TGG ACT C		
	EaparC2_F	CTG AAT CAT CGT CTG GAA AAA GTG	62	732
	EaparC2_R	GAC GAA ACC ATA ACC GGC ATC AGA		

Supplementary Table 3. Amino acid changes in DNA gyrase conferring quinolone resistance in Gram-negative bacteria

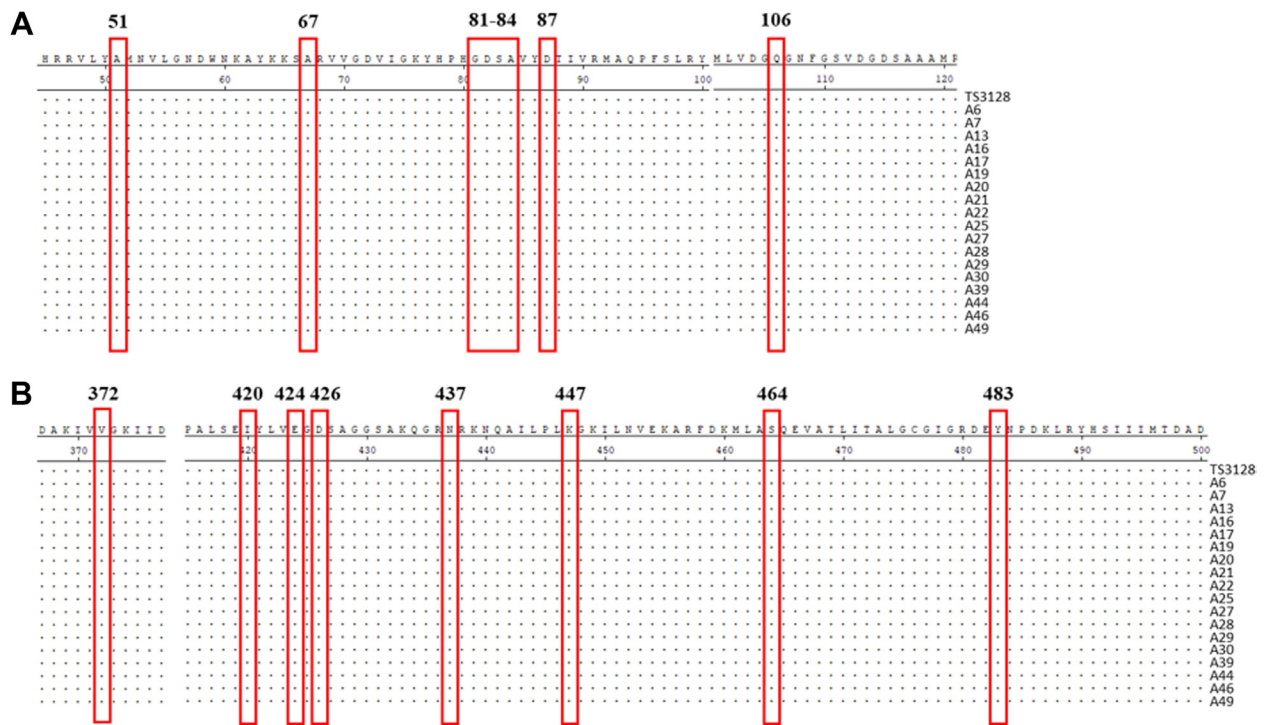
Species	Gene	Codon	Wild-type	Mutant	Reference	
<i>Escherchia coli</i>	<i>gyrA</i>	51	Ala	Val	Ruiz (2003)	
		67	Ala	Ser		
		81	Gly	Cys, Asp		
		82	Asp	Gly		
		83	Ser	Leu, Trp, Ala, Val		
		84	Ala	Pro, Val		
		87	Asp	Gly, Asn, Val, Tyr, His		
		106	Gln	Arg, His		
		<i>gyrB</i>	426	Asp		Asn
			447	Lys		Glu
<i>Burkholderia glumae</i>	<i>gyrA</i>	81	Gly	Cys, Asp	Maeda et al. (2007)	
		82	Asp	Gly		
		83	Ser	Arg, Ile		
		87	Asp	Gly, Asn		
<i>Pseudomonas aeruginosa</i>	<i>gyrA</i>	83	Thr	Ile	Yonezawa et al. (1995)	
		87	Asp	Asn, Gly, His		
	<i>gyrB</i>	372	Ala	Val, Leu	Feng et al. (2019)	
		424	Ile	Leu		
		464	Leu	Ile		
<i>Salmonella enterica</i> serovar Typhimurium	<i>gyrA</i>	83	Ser	Phe	Eaves et al. (2004)	
		87	Asp	Asn, Tyr		
	<i>gyrB</i>	420	Tyr	Cys		
		437	Arg	Leu		
	<i>Erwinia amylovora</i>	<i>gyrA</i>	81	Gly		Cys
83			Ser	Arg		

References

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Supplementary Fig. 1. Oxolinic acid Sensitivity of *Erwinia amylovora* isolates. The representative 18 strains isolated in 2020 are shown. Each *Ea* isolate collected from apple and pear orchards in Korea was streaked onto tryptic soy agar (TSA) media with or without supplementation with 19.14 μ M of oxolinic acid (OA) and then incubated at 27°C for 48 h. PC, positive control (*Ea* OX15); NC, negative control (*Ea* TS3128).



Supplementary Fig. 2. Potential mutation sites in *gyrA* and *gyrB* of *Erwinia amylovora* isolates. Eighteen representative strains collected in 2020 are shown. The numbers refer to the amino acid position in either GyrA (A) or GyrB (B).