

Table S4. Recombination events mediated by short direct repeats in the *Arabidopsis* plastid genome

Event	Related ¹ Events	Reaction	Plant lines	DR positions	Short direct repeat sequences and junction	DR length and (mismatches)
1		5291REV DUP/CIR ² 20481FOR	KO1/3	5204 recombinant 21835	aaaagtttgaTTAGTTATGGGatcataaaaa agtaggttttTTAGTTATGGGatcataaaaa agtaggttttTTAGTTATGGGcctagcaaaa	(0) 11 bp (0)
2		19181FOR DEL ³ 31138REV	KO1/3	19766 recombinant 30894	ccatatctcaATAGATTGgcgtaat ccatatctcaATAGATTGcctcatctca actttccttgATAGATTGcctcatctca	(0) 8 bp (0)
3		20481REV DUP/CIR 30511FOR	KO1,KO3 KO1/3	20366 recombinant 31005	aatatatataCAAAAATTTTCTTTTTTtacacttctta gttaagttatCAAAAATTTGCTTTTTTtacacttctta gttaagttatCAAAAATTTGCTTTTTTTTTtttttagaa	(1) 18 bp (0)
4 ⁴		20481REV DUP/CIR 30511FOR	KO1/3	30300 recombinant 30827	gtcatttatgCAAAAAAAAAAAtggttatgta attggtctaaCATAAAAAAAAAAAtggttatgta attggtctaaCATAAAAAAAAAAagaaaaaag	(1) 14 bp (0)
5		30511REV DUP/CIR 40130FOR	KO1/3	29711 recombinant 40160	gaccctttctTTTGCTTTATgaaaaaagaa aaaaccaagaTTTGCTTTATgaaaaaagaa aaaaccaagaTTTGCTTTATctggatttaa	(0) 10 bp (0)
6	23	40130REV DUP/CIR 50251FOR	KO1/3	38989 recombinant 50299	cccctggatgCAGGAATAGCgacatggact aatgccaaaaCAGGAATAGCgacatggact aatgccaaaaCAGGAATAGCacttgatatt	(0) 10 bp (0)
7		40130REV DUP/CIR 50251FOR	KO1/3	39109 recombinant 50758	cttggttccATTTTGGTTGtaggtgtaac gatagattgaATTTTGGTTGtaggtgtaac gatagattgaATTTTGGTTGaatttaatta	(0) 10 bp (0)

8		40130REV DUP/CIR 50251FOR	KO1/3	39266 recombinant 51611	cacctcctcgAGT <u>A</u> aacgcttcca cattctacctAGCAaacgcttcca cattctacctAGCAttgagtagac	(1) 4 bp (0)
9		40130REV DUP/CIR 50251FOR	KO1	39411 recombinant 50322	gtccacagaaAAAttattgctaa tgatattagtAAAttattgctaa tgatattagtAAAatgccaga	(0) 3bp (0)
10		40130REV DUP/CIR 50251FOR	KO3	39586 recombinant 50325	ttaatgccataAATGCCtttcaaatcc tattagtaaaAATGCCtttcaaatcc tattagtaaaAATGCCcagaaaatat	(0) 6 bp (0)
11	25,35	50251FOR DEL 60182REV	KO1/3	50780 recombinant 59406	tttaattagaTTTCTTTTTTTTATTTTTAAAcaggccgtg tttaattagaTTTCTTTTTTTTATTTTTAAAaacttcgatt tcatatcaccTTTTTTTTTTTTATTTTAAAAaacttcgatt	(0) 20 bp (2)
12		50251FOR DEL 60182REV	KO1/3	50847 recombinant 59726	gggatacaaaaAAAAAAAAAGAAAGTattatgaact gggatacaaaaAAAAAAAAAGAAAGTcatattttct ctttgaaaacAAAAAAAAAGAAAGTcatattttct	(1) 15 bp (0)
13	14,18,21,22,24	50251FOR DEL 60182REV	KO1/3	50474 recombinant 59953	aggttaatcgAATCATTTTTTTTTCgtttggttg aggttaatcgAATCATTTTTTTTTCcacaagggat cgtcccagcaAATCATTTTTTTTTCcacaagggat	(0) 14 bp (0)
14	13,18,21,22,24	50513REV DUP/CIR 68821FOR	KO1/3	50488 recombinant 70515	aaattcagggtTAATCGAATCATTTTTTTTTCgtttggttg tttcaatataTAATCGAATCATTTTTTTTTCgtttggttg tttcaatataTAATCGAA---TTTTTTTTtaatctaaaa	(0) 19 bp (3)
15		50513REV DUP/CIR 68821FOR	Col-0 KO1,KO3 KO1/3	50427 recombinant 69424	aattccaatcGGAGTGGATTGGgcaaggata tctaaaaaatGGAGTTGATTGGgcaaggata tctaaaaaatGGAGTTGATTGGatttgcacca	(1) 12 bp (0)
16	17	50513REV DUP/CIR 68821FOR	KO1/3	48553 recombinant 68998	tagaattgtaTCCCCCCTTCATTTATTGCTttccgatctt actctaacctTCCCCCCTTCATTTATTGCTttccgatctt actctaacctTCCCC <u>ACCACT</u> ATTTTTTGGCTaggtattttc	(0) 21 bp (5)

17	16	50513REV DUP/CIR 68821FOR	KO1 KO1/3	49181 recombinant 68999	tttttatttcCCCCACACCTTTTTTatataaaatt ctctaacccttCCCCACACCTTTTTTatataaaatt ctctaacccttCCCCAC <u>CACTAT</u> TTTTtgctaggta	(0) 15 bp (3)
18	13,14,21,22	50513REV DUP/CIR 68821FOR	KO1	50482 recombinant 70117	caaaaattcaGGTTAAT <u>CGAAT</u> CATTtttttttcggt cgaactagcggGTTGAT-GGATCATTtttttttcggt cgaactagcggGTTGAT-GGATCATTaccctgatga	(3) 15 bp (0)
19		50513REV DUP/CIR 68821FOR	KO1/3	50243 recombinant 70143	tacctgattcATAAC <u>TAGAAA</u> gtttctccgg ccctgatgatATAA-TAGAAAagtttctccg ccctgatgatATAA-TAGAAAaggtttttct	(1) 10 bp (0)
20		50513REV DUP/CIR 68821FOR	KO3	49972 recombinant 70402	gttttttttaCTTTTTTTTTTTTTAttattgtatc cccaaagtgtCTTTTTTTTTTTTTAttattgtatc cccaaagtgtCTTTTTTTTTTTTTTAcggtgtgaaa	(0) 15 bp (0)
21	13,14,18,22,24	50513REV DUP/CIR 59291REV	Col-0 KO1,KO3 KO1/3	50489 recombinant 59938	aggttaatcgAATCATTTTTTTTTCgtttggtgt cgtcccagcaAATCATTTTTTTTTCgtttggtgt cgtcccagcaAATCATTTTTTTTTCcacaagggat	(0) 14 bp (0)
22	13,14,18,21,24	50513REV DUP/CIR 59291REV	KO1/3	50489 recombinant 59936	tcaggttaatCGAATCATTTTTTTTTCgtttggttg tccgtcccagCGAATCATTTTTTTTTCgtttggttg tccgtcccagCAATCATTTTTTTTTCcacaagggat	(0) 16 bp (1)
23	6	50513REV DUP/CIR 59291REV	KO1/3	50309 recombinant 60067	atgccaaaacAGGAATAGcacttgat accgaaaagaAAGAATAGcacttgat accgaaaagaAGGAATAGtgcgtat	(0) 8 bp (0)
24	13,14,21,22	50513REV DUP/CIR 59291REV	KO1/3	50495 recombinant 60081	gaatcattttTTTTCGTTGGTtggtgtggt tagtgcgatTTTTCGTTGGGttggtgtggt tagtgcgatTTTTCGTTGGGgatttctcgg	(1) 11 bp (0)
25	11,32,35	54551REV DUP/CIR 58730FOR	KO1/3	54523 recombinant 59387	ctcattagccTTTTTTTTTCGTATTTTcatttagca catatcacctTTTTTTTTTCGTATTTTcatttagca catatcacctTTTTTTTTT-TTATTTTaaaaactcgg	(0) 16 bp (2)

26		59291REV DUP/CIR 69633FOR	KO1/3	58721 recombinant 70186	attagactagACAAACAAAAAAAAgttcattttc agacgggataACAAACAAAAAAAAgttcattttc agacgggataACAA <u>AAAA</u> AAAAAAAAatagataaat	(0) 14 bp (1)
27	28	59291REV DUP/CIR 69633FOR	KO1/3	59287 recombinant 70228	acttaccctcTATTTTTGTGCCTTtagtaggcct ccgtacaggcTTTTTTGTGCCTTtagtaggcct ccgtacaggcTTTTTTGTGCATTgcatacggct	(1) 14 bp (1)
28	27	59291REV DUP/CIR 69633FOR	KO1/3	59028 recombinant 70225	tatttagtttGGCTTTTTTTGTacctatTTTT taaccgtacaGGCTTTTTTTGTacctatTTTT taaccgtacaGGCTTTTTTTGTgcattgcata	(0) 12 bp (0)
29	30, 36	59291REV DUP/CIR 69633FOR	KO1/3	59039 recombinant 69901	ttttttgtaCCTATTTTTTtattctattt tgaaatcgctCCTATTTTTTtattctattt tgaaatcgctCCTATTTTTTattgaaccgc	(0) 10 bp (0)
30	29,35,36	59291REV DUP/CIR 69633FOR	KO3 KO1/3	59043 recombinant 69807	ttttgtaccTATTTTTTATTctatttctat ttctcttcaaTATTTTTTATTctatttctat ttctcttcaaTATTTTTTATTtttatattga	(0) 12 bp (0)
31		59311FOR DEL 69633REV	KO1/3	59307 recombinant 68984	tctttccggcAATTGCAATGGCTTctttatttct tctttccggcAATTGCAATGGCTTtgctactct gtataaaaaAATT <u>CA</u> ATGGCTTtgctactct	(0) 14 bp (1)
32	25,36	59311FOR DEL 69633REV	KO1/3	59380 recombinant 68522	accgaatcatATC <u>AC</u> CTTTTTTTTTtattttaaaa accgaatcatATCCCCTTATTTTTTTatgtcattcg atttcttccaATCCCCTTATTTTTTTatgtcattcg	(2) 16 bp (0)
33		58730FOR DEL 69941REV	KO1/3	58973 recombinant 69303	acatctagttGTAGTTGATTTGAAAGATGAataagtccat acatctagttGTAGTTGATTTGAAAGATGAattaggtcatt tacagtaacgGTATTT <u>CA</u> TTTTGAAAATTGattaggtcatt	(0) 21 bp (4)
34		58730FOR DEL 69941REV	KO1/3	59590 recombinant 69740	gtatataactATAGGGGATCATATAAAggaaggagat gtatataactATAGGGGATCATATAAAtaatgggctg aatggttggcATAC <u>CGA</u> ATCATATAAAtaatgggctg	(0) 17 bp (2)

35	11,25,30,32	58730FOR DEL 69941REV	KO1/3	59390 recombinant 69822	atcaccttttTTTTTTATTTTaaaaacttcg atcaccttttTTTTTTATTTTtatattgaag ctcttcaataTTTTTTATTTTtatattgaag	(0) 12 bp (0)
36	30,32	58730FOR DEL 69941REV	KO1/3	59030 recombinant 68524	ttttgtaccTATTTTTTATtctatttcta ttttgtaccTATTTTTTATgtcattcgaa ccaatcccctTATTTTTTATgtcattcgaa	(0) 11 bp (0)
37		58730FOR DEL 69941REV	KO1/3	59074 recombinant 69714	ctattctataTATTTCTATTAGGTTGTATattaatattag ctattctataTATTTCTATTAGGTTGTTTAatggttggca tggctgtctgTATTTCTAATAAGTTGTTTAatggttggca	(1) 20 bp (2)
38		69633REV DUP/CIR 79920FOR	KO1/3	69468 recombinant 80032	atgtaaaccaTAAGTTTCAGAcacaatagag tcacaaattgTAAGTTACAGAcacaatagag tcacaaattgTAAGTTACAGAtatctaattt	(1) 11 bp (0)
39		79920REV DUP/CIR 111330FOR	KO1/3	78747 recombinant 111896	aagctcttcgCATcgcaatgcct ggtaaccataCATcgcaatgcct ggtaaccataCATgaagaggaaa	(0) 3 bp (0)
40		79920REV DUP/CIR 111330FOR	KO1/3	76183 recombinant 111428	tgggcagcaaAGGGTGTTCCTCTTcttgtacccc ccacaaagagAGAGTGTTCCTCTTcttgtacccc ccacaaagagAGAGTGTTCCTATTaaaaaggccg	(1) 14 bp (1)
41		79920REV DUP/CIR 111330FOR	KO1/3	78830 recombinant 111688	ataataaagaCGCTTACTGTCTCTTTttgattcaac ggctaaaccCGCTTACTGTCTCTTTttgattcaac ggctaaaccCGCTTAATGTCTTTTgagcaagagc	(0) 16 bp (2)
42		84761REV DUP/CIR 95260FOR	KO1/3	84370 recombinant 95699	acggcgacgaAGAATCAAAGTctcactatatt ctggagtgggAGAATCAAAGTctcactatatt ctggagtgggAGAGTCAGAGTCgaaaagagga	(0) 13 bp (2)
43		105983REV DUP/CIR 116007FOR	KO1/3	104982 recombinant 116127	gtgggagagcAAAAAAGcgtcgtgctg tcctgccaagAAAAAAGcgtcgtgctc tcctgccaagAAAAAAGtgcagcgcca	(0) 8 bp (0)

44		105983REV DUP/CIR 116007FOR	KO1 KO1/3	105322 recombinant 116009	<p>tggttggttAAGGGAACCCACCGgagccgtagc</p> <p>ccggcaatgcAAGGGAACCCACCGgagccgtagc</p> <p>ccggcaatgcAAGGGAAGCCATCGataaaatagt</p>	<p>(0)</p> <p>14 bp</p> <p>(2)</p>
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¹ Related events implicate at least part of a direct repeat that is found independently in another recombination event.

² DUP/CIR = Illegitimate recombination event yielding a duplicated/circularized product and detected using outward-facing PCR.

³ DEL = Illegitimate recombination event yielding a deletion-containing product and detected using inward-facing PCR.

⁴ Non-specific annealing of primer 20481REV at positions 30367-30346 yielded this product.

