Efficient genome editing and gene knockout in *Setaria viridis* with CRISPR/Cas9 directed gene editing by the non-homologous end-joining pathway

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SUPPLEMENTARY MATERIAL

Supplementary Table S1. Top 20 off-target sites of the gRNA used in this study predicted in *Setaria viridis* genome using the CCTop software.

Coordinates	Strand[1]	Mismatches	Target sequence[2]	PAM	Distance[3]		Gene name/ID
Chr_09:14268254-14268276 [*]	+	4	GACAAGGA[TGGGGATGTGAA]	GGG	492	-	Sevir.9G201200.1
Chr_02:34471610-34471632	-	3	GTAGTGGA[TGGTGAGGTGAA]	GGG	1915	-	Sevir.2G263600.1
Chr_04:11547181-11547203 [#]	+	4	GATCTGGC[TCCTGATGTGAA]	AGG	10812	-	Sevir.4G118700.1
Chr_03:710993-711015	-	4	CAGCTGGA[TTGTGGTGTGAA]	TGG	0	E	Sevir.3G011900.1
Chr_06:2592841-2592863	+	4	GAATTGAA[AGGTGGTGTGAA]	GGG	16	-	Sevir.6G032200.1
Chr_01:35855582-35855604	+	4	GACCTGGC[TGTTCATGTGAA]	AGG	0	E	Sevir.1G306300.1
Chr_04:22260779-22260801	-	4	GTTCTGGA[TGGAGAGGTGAA]	TGG	2630	-	Sevir.4G161600.1
Chr_03:17717572-17717594	+	4	GAACTAAA[TGCTGACGTGAA]	AGG	328	-	Sevir.3G229500.1
Chr_04:37352407-37352429	+	4	GAACGCGA[TGGAGAGGTGAA]	CGG	0	E	Sevir.4G273400.1
Chr_09:29625651-29625673	-	4	GATCTAGA[TGGGGATGAGAA]	GGG	41334	-	Sevir.9G287800.1
Chr_05:37149828-37149850	+	4	AAAATGGA[TGGTCATGCGAA]	AGG	0	E	Sevir.5G340200.1
Chr_03:31687859-31687881	+	4	GAGCTTGA[CGGTGATGTCAA]	TGG	47468	-	Sevir.3G311300.1
Chr_03:2349442-2349464	+	4	GAAATTGT[TGGTGATGTGCA]	TGG	0	E	Sevir.3G037400.1
Chr_05:37023083-37023105	-	4	GACCCGGA[GGGTGATGTGGA]	AGG	3399	-	Sevir.5G338300.1
Chr_09:9774624-9774646	-	4	GCGCTGGA[TGGGGATGTGGA]	GGG	1911	-	Sevir.9G151700.2
Chr_06:7819868-7819890	+	4	GGTCTGGA[TGGTCATGTGGA]	GGG	0	E	Sevir.6G085300.1
Chr_01:34163227-34163249	-	4	GGTCTGGA[TGGTCATGTGGA]	GGG	0	E	Sevir.1G283100.1
Chr_05:4493822-4493844	+	4	GTACGGGG[TGGTGATGTGAC]	TGG	0	E	Sevir.5G057500.1
Chr_05:14897355-14897377	-	4	GAGGTGGA[TGGTGGTGTGGA]	GGG	5970	-	Sevir.5G161500.1
Chr_01:33115978-33116000	-	4	GAACTAGG[TGATGATGTGAT]	CGG	384	-	Sevir.1G269600.1

[1] Orientation of the off-target site.

[2] Off-target sequence are show with highlighted mismatches in red, while core sequence in square brackets.

[3] Distance to the closest exon (0 if target site and exon coordinates overlap); Legend for off-target site positon: E = exonic; I = intronic; - = intergenic.

[#] named in this work of off-target 1

[*] named in this work of off-target 2

Supplementary Table S2. Primer sets used in this study.

| Gene	ID or position	Goal	Primer name	Sequence 5' - 3'	Reference
bar	Binary vector	PCR	BAR(F)	ACCATCGTGACCACTACATC	This work
			BAR(R)	GTGCCTGCACATCAACAAAT	
*Zm*UBI:GFP	Binary vector	PCR	*Zm*UBI(F)	TGTGTTAGATCCGTGCTGCT	This work
			GFP(R)	CATGTGGTCCCTCTTCTCGT	
Translation factor *SUI1*	Sevir.2G348300	qPCR	*Sv*SUI(F)	CCAGAGCTTGGACAGGTCATTC	(Martins et al., 2016)
			*Sv*SUI(R)	ACAATGCCAGCCTGGACAA	
gfp transgene	-	qPCR	GFPq(F)	CTACGGTGTTCAGTGCTTCTC	This work
			GFPq(R)	GTGTCTTGTAGTTCCCGTCATC	
Off-target1	Chr_09:14268254-14268276	PCR	Off-target1(F)	CTCATCACGACCATAAGCAGC	This work
			Off-target1(R)	GAGAATCAGCCACGGGTCAA	
Off-target2	Chr_04:11547181-11547203	PCR	Off-target2(F)	ATCTGAAGTGGCACAGCCAA	This work
			Off-target2(R)	TGTGCAGAGCATTGGGTCAT	

Supplementary Table S3: Decoding of mono and biallelic *indels* introduced by CRISPR/Cas9 NHEJ system in *gfp* transgene. For decoding were performed the direct Sanger sequencing of PCR products from the target gene of *Setaria viridis* co-transforming EC1 to EC10 events compared with ECWT1 and ECWT2 plant (GFP-positive controls, wild-type *gfp* gene, and negative control for genome editing).

Events	Chromatogram analysis and degenerate nucleotide sequence	Results of genome edition
ECWT1	GGATGGTGATGTGAACGGGCAC	Non-edited control lineage 1
ECWT2	GGATGGTGATGTGAACGGGCAC	Non-edited control lineage 2

EC1	GGAACTGGATGGTGAT $^T/_G$ $^T/_G$ $^G/_A$ A $^C/_A$ $^C/_G$ GGC $^A/_C$ C $^A/_C$ (possibilities from chromatogram)
	GGAACTGGATGGTGAT K K R A M S GGC M C M (degenerate nucleotides)
	GGAACTGGATGGTGAT G G A A G GGC A C A (possibilities 1)
	GGAACTGGATGGTGAT T T G A C C GGC C C C (possibilities 2)
	Alignments:
	ECWT lineage GGAACTGGATGGTGATGTGAACGGGCAC-
	EC1 lineage GGAACTGGATGGTGAT-KKRAMSGGCMCM
	Allele 1 GGAACTGGATGGTGAT TGAACGGGCACA
	                  *****************-***********
	
	ECWT lineage GGAACTGGATGGTGATGTGAACGGGCAC
	Allele 2 GGAACTGGATGGTGATGTGAACGGGCAC
	                  ****************************
	
	[] Information retrieved of chromatogram from reverse sequencing
		Allele 1: deletion of G nucleotide at position 5 upstream to the PAM sequence.
		Allele 2: no indels. Therefore, the EC1 event has the *gfp* transgene knocked out in a single allele (heterozygous or monoallelic mutant).

EC2	GGAACTGGATGGTGATG $^A/_T$ $^A/_T$ $^C/_G$ $^C/_A$ $^G/_A$ $^C/_G$ $^C/_G$ $^A/_G$ $^C/_G$ $^C/_A$ A
	GGAACTGGATGGTGATG W W S M R S S R S M A
	GGAACTGGATGGTGATG A A G A A G G A G A A
	GGAACTGGATGGTGATG T T C A G C C G C C A
	Alignments:
	ECWT lineage GGAACTGGATGGTGATG-TGAACGGGCAC
	EC2 lineage GGAACTGGATGGTGATGWWSMRSSRSMA-
	Allele 1 GGAACTGGATGGTGATGATGAACGGGCA-
	                  ******************-***********-
	
	ECWT lineage GGAACTGGATGGTGATGTGAACGGGCACAA
	Allele 2 GGAACTGGATGGTGATGT--ACGGGCACAA
	                  ******************--**********
	
	[] Information retrieved of chromatogram from reverse sequencing
		Allele 1: insertion of A nucleotide at position 5 upstream to the PAM sequence.
		Allele 2: deletion of GA nucleotides at positions 2 and 3 upstream to the PAM sequence. Therefore, the EC2 event has the *gfp* transgene knocked out in both alleles (biallelic mutant).

EC3	**Chromatogram from forward sequencing:** GGAACTG $^T/_G$ $^A/_T$ $^C/_T$ $^G/_A$ $^C/_G$ $^A/_T$ $^G/_A$ G $^A/_T$ $^A/_T$ C $^T/_G$ $^C/_G$ $^C/_G$ $^C/_G$ $^A/_T$ CA $^G/_A$ $^G/_C$ $^T/_G$ GGAACTG K W Y R S W R G W W C K S S S W CA R S K GGAACTG G A C A G A A G A A C G G G G A CA A G G GGAACTG T T G C T G G T T C T C C C T CA G C T Alignments:	Allele 1: deletion of ATGT nucleotides at positions 4 to 7 upstream to the PAM sequence. Allele 2: two deletions of G nucleotide at positions 14 and 11 upstream to the PAM sequence. Therefore, the EC3 event has the *gfp* transgene knocked out in both alleles (biallelic mutant).

```
ECWT lineage  GGAACTGGATGGTGATGTGAACGGGCACAAGT
EC3 lineage   GGAACTGKWYRSWR----GWWCKSSSWCARSK
Allele 1      GGAACTGGATGGTG----GAACGGGCACAAGT
              ***************---—**********????

ECWT lineage  GGAACTGGATGGTGATGTGAACGGGCACAA
Allele 2      GGAACTG-TT-CACAAGTTCTCCGTCACAA
              *******--*----*-*----*-*-*****
```

[] Information retrieved of chromatogram from reverse sequencing

Chromatogram from reverse sequencing
```
GACGGAGAACTTGTG A/C A/C C G/A T/G T T/C C A C C/A T/A  C C/G A T/G T T/G C/G C/G
GACGGAGAACTTGTG M   M   C R K T Y C A C M   W   C S A K T   K   S   S
GACGGAGAACTTGTG A   A   C G T T  C A C C T   C   C A A T   G   C   C
GACGGAGAACTTGTG C   C   C A G T C C A C A   C   G A T T   T   G   G
```
Alignments:
```
ECWT lineage  GACGGAGAACTTGTGCCCGTTCACATC-ACCA-T-CC
EC3 lineage   GACGGAGAACTTGTGMMCRKTY-CA-CMWCSAKTKSS
Allele 1      GACGGAGAACTTGTGCCCGTTC-CA-CCACCATTGCC
              ***********************-**-*-****-*-**

ECWT lineage  GACGGAGAACTTGTG--CCC-GTTCACATC-ACC-ATCCAGTTCC
Allele 2      GACGGAGAACTTGTGAA--CAGTTCACATCGA--GTT-CAGTTCC
              ***************----*-********-*----*-********
```

[] Information retrieved of chromatogram from forward sequencing

	or	
	Allele 1: deletions of A and T nucleotides at positions 4 to 7 and insertions of C/A, T and G nucleotides at positions 9, 14 and 16 downstream to the PAM sequence.	
	Allele 2: insertions of AA, A, G and G nucleotides at positions 2 and 3 upstream, deletions of C nucleotides at positions 11 to 12 and 16 downstream to the PAM sequence. Therefore, the EC3 event has the *gfp* transgene knocked out in both alleles (biallelic mutant).	

EC4
```
GGAACTGGATGGTGAT T/G T/G A G/A C/A G/A G/C G G/C G/A CA A/C G/A
GGAACTGGATGGTGAT K   K   A R M   R   S G S   R   CAM   R
GGAACTGGATGGTGAT T   T   A G C   G   G G G   CAA   G
GGAACTGGATGGTGAT G   G   A A A   C   G C A   CAC   A
```
Alignments:
```
ECWT lineage  GGAACTGGATGGTGATGTGAACGGGCACAAG
EC4 lineage   GGAACTGGATGGTGAT-KKARMRSGSRCAMR
Allele 1      GGAACTGGATGGTGAT-TGAACGGGCACAAG
              ****************-**************

ECWT lineage  GGAACTGGATGGTGATGT-GAACGGGCACA
Allele 2      GGAACTGGATGGTGATGTAGAACGGGCACA
              ******************-*-*********
```

[] Information retrieved of chromatogram from forward sequencing

Allele 1: deletion of G nucleotide at position 5 upstream to the PAM sequence.
Allele 2: insertion of A nucleotide at position 4 upstream to the PAM sequence. Therefore, the EC4 event has the *gfp* transgene knocked out in both alleles (biallelic mutant).

EC5
```
GGAACTGGATGGTGAT T/G G/A A C/A C G/A C/G C/G A/C A/C CA A/C T/G
GGAACTGGATGGTGAT K   R   A M   C R   S   S   M   M   CAM   K
```

Allele 1: deletion of G nucleotide at position 5 upstream to the PAM sequence.

6

```
GGAACTGGATGGTGAT T  G  A  C  C  G  C  C     A  A  CA A     T
GGAACTGGATGGTGAT G  A  A  A  C  A  G  G     C  C  CA C     G
```

Alignments:
```
ECWT lineage   GGAACTGGATGGTGATGTGAACGGGCACAAG
EC5 lineage    GGAACTGGATGGTGAT-KRAMCRSSMMCAMK
Allele 1       GGAACTGGATGGTGAT-TGAACGGGAACAAG
               ****************_**************
```

```
ECWT lineage   GGAACTGGATGGTGATGTGAACGGGCACA
Allele 2       GGAACTGGATGGTGAT--GAACGGGCACA
               ****************__***********
```

[] Information retrieved of chromatogram from reverse sequencing

Allele 2: deletions of GT nucleotides at positions the 4 to 5 upstream to the PAM sequence.
Therefore, the EC5 event has the *gfp* transgene knocked out in both alleles (biallelic mutant).

EC6

```
GGAACTGGATGGTGATG A/T A/T C/G A/G A/G C/G C/G G/A C/G C/A A
GGAACTGGATGGTGATG  W   W   S   R   R   S   S   R   S   M   A
GGAACTGGATGGTGATG  A   A   C   A   C   C   G   C   C   A
GGAACTGGATGGTGATG  T   T   G   G   G   G   G   A   G   A   A
```

Alignments:
```
ECWT lineage   GGAACTGGATGGTGATGTGAACGGGCACAA
EC6 lineage    GGAACTGGATGGTGATG--WWSRRSSRSMA
Allele 1       GGAACTGGATGGTGATG--AACGGGCACAA
               *****************__***********
```

```
ECWT lineage   GGAACTGGATGGTGATG-TGAACGGGCA
Allele 2       GGAACTGGATGGTGATGTTGAACGGGCA
               *****************_**********
```

Allele 1: deletion of TG nucleotides at position 3 to 4 upstream to the PAM sequence.
Allele 2: insertion of T nucleotide at position 5 upstream to the PAM sequence. Therefore, the EC6 event has the *gfp* transgene knocked out in both alleles (biallelic mutant).

EC7

```
GGAACTGGATGGTGATG A/T A/G A A/C G/C GG C/G A/C A/C A/C
GGAACTGGATGGTGATG  W   R   A   M   S   GG  S   M   M   M
GGAACTGGATGGTGATG  A   A   A   G   GG  C   A   A   A
GGAACTGGATGGTGATG  T   G   A   C   C   GG  G   C   C
```

Alignments:
```
ECWT lineage   GGAACTGGATGGTGATGTGAACGGGCAC
EC7 lineage    GGAACTGGATGGTGATGWRAMSGGSMMM
Allele 1       GGAACTGGATGGTGATGTGAACGGGCAC
               ****************************
```

```
ECWT lineage   GGAACTGGATGGTGATGTGAACGGGCACA
Allele 2       GGAACTGGATGGTGATG--AACGGGCACA
               *****************__**********
```

[] Information retrieved of chromatogram from reverse sequencing

Allele 1: no indels.
Allele 2: deletion of TG nucleotides at positions 3 to 4 upstream to the PAM sequence. Therefore, the EC7 event has the *gfp* transgene knocked out in a single allele (heterozygous or monoallelic mutant).

EC8

```
GGAACTGGATGGTGATG T/G A/G A A/C C/G GG C/G A/C A/C A/C
GGAACTGGATGGTGATG  K   R   A   M   S   GG  S   M   M   M
```

Allele 1: deletion of T nucleotide at position 4 upstream to the PAM sequence.

```
GGAACTGGATGGTGATG T  A  A  C  GG C  A  A
GGAACTGGATGGTGATG G  G  A  C  G  GG G  C  C
Alignments:
ECWT lineage    GGAACTGGATGGTGATGTGAACGGGCACA
EC8 lineage     GGAACTGGATGGTGATGKRAMSGGSMMM
Allele 1        GGAACTGGATGGTGATG-GAACGGGCACA
                *****************-***********

ECWT lineage    GGAACTGGATGGTGATGTGAACGGGCAC
Allele 2        GGAACTGGATGGTGATGTGAACGGGCAC
                ****************************
```

Allele 2: no indels. Therefore, the EC8 event has the *gfp* transgene knocked out in a single allele (heterozygous or monoallelic mutant).

EC9

```
GGAACTGGATGGTGATG A/T G/A C/A A/G C/G G G/C G/A C C/A C/A
GGAACTGGATGGTGATG W  R  M  R  S  G  S  R  C  M  M
GGAACTGGATGGTGATG A  G  C  A  C  GG G  C  A  C
GGAACTGGATGGTGATG T  A  A  G  G  GC A  C  C  A
Alignments:
ECWT lineage    GGAACTGGATGGTGATGTGAACGGGCACAC
EC9 lineage     GGAACTGGATGGTGATGWRMRSGSRCMM
Allele 1        GGAACTGGATGGTGATGTGAACGGGCACAC
                ******************************

ECWT lineage    GGAACTGGATGGTGATGTGAACGGGCACAC
Allele 2        GGAACTGGATGGTGATG--AACGGGCACAC
                *****************--***********
```

[] Information retrieved of chromatogram from reverse sequencing

Allele 1: no indels.
Allele 2: deletion of TG nucleotides at positions 3 to 4 upstream to the PAM sequence. Therefore, the EC7 event has the *gfp* transgene knocked out in a single allele (heterozygous or monoallelic mutant).

EC10

```
GGAACTGGATGGTGATG G/A A  A/C C/G GG G/C AC A/C A
GGAACTGGATGGTGATG R  A  M  S  GG S  AC M  A
GGAACTGGATGGTGATG G  A  C  GG G  AC A  A
GGAACTGGATGGTGATG A  A  C  G  GG C  AC C  A
Alignments:
ECWT lineage    GGAACTGGATGGTGATGTGAACGGGCACAC
EC10 lineage    GGAACTGGATGGTGATGRAMSGGSACMA
Allele 1        GGAACTGGATGGTGATG--AACGGGCACAC
                *****************--***********

ECWT lineage    GGAACTGGATGGTGATGTGAACGGGCACAC
Allele 2        GGAACTGGATGGTGATG-GAACGGGACCAC
                *****************-***********
```

[] Information retrieved of chromatogram from reverse sequencing

Allele 1: deletions of TG nucleotides at positions 3 to 4 upstream to the PAM sequence.
Allele 2: deletion of T nucleotide at position 3 upstream to the PAM sequence. Therefore, the EC10 event has the *gfp* transgene knocked out in both alleles (biallelic mutant).

8
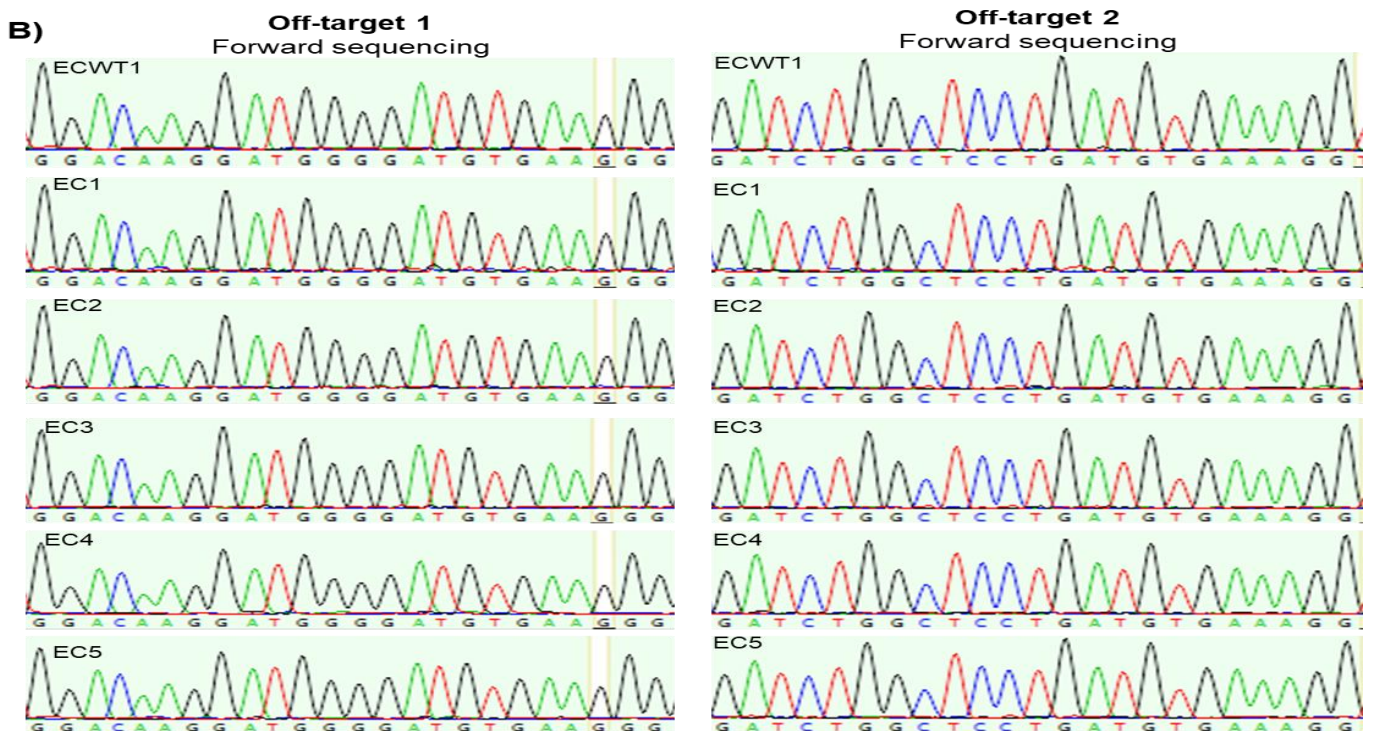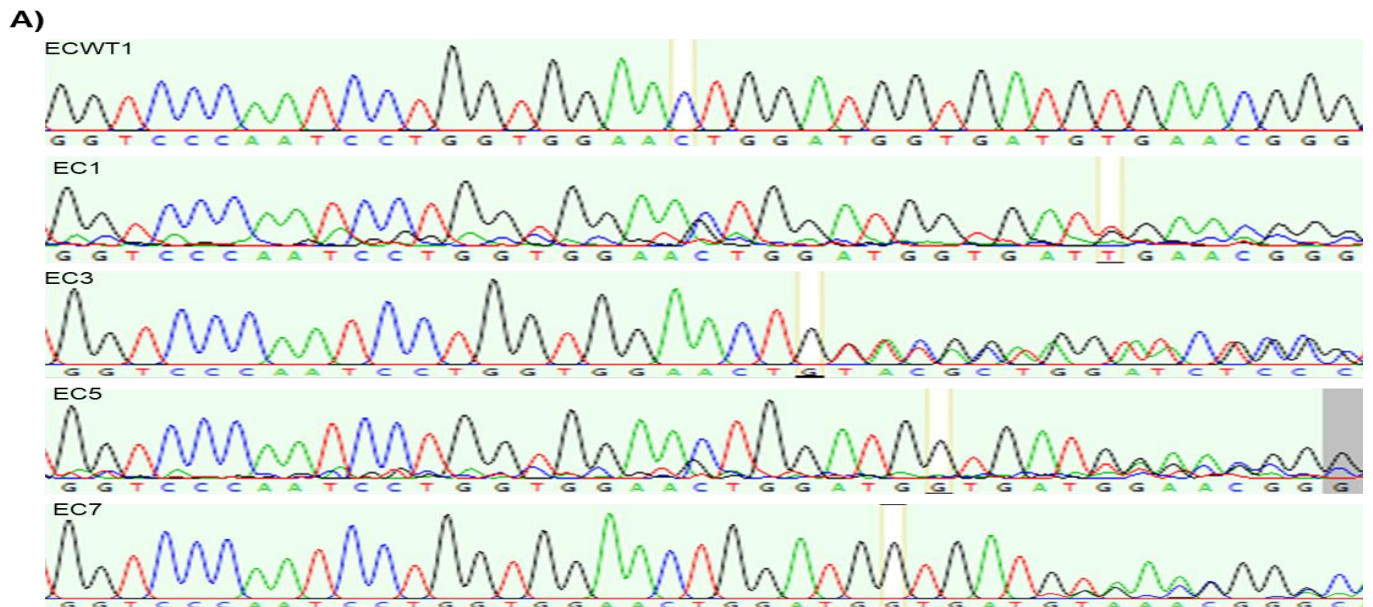
Supplementary Figure S1. Inheritance *indels* induced by CRISPR/Cas9 NHEJ system and absence of off-targets. **(A)** Inheritance and stability of mutations induced by CRISPR/Cas9 from T_0 to T_1 generation. Sanger sequencing of PCR products from the ZmUBI:GFP target sequence of the CRISPR/Cas9 NHEJ system. Sequencing forward and reverse were carried out using ZmUBI(F) and GFP(R) primers (Supplemental Table S2). The co-transforming EC1, EC3, EC5, and EC7 events compared to ECWT1 plants (wild-type *gfp* gene, negative control for edition) from T_1 generation. **(B)** Absence of putative off-targets in regions outside the target induced by the CRISPR/Cas9 NHEJ system. Sanger sequencing of PCR products from top three predicted off-target sites (Supplemental Table S1) in the co-transforming EC1 to EC5 events compared with ECWT1 plants (wild-type *gfp* gene, negative control for edition) from T_0 generation. PCR and sequencing were performed using primers flanking the off-target sites (Supplemental Table S2).

Supplementary File S1. Nucleotide and deduced amino acid sequences of the *gfp* gene used in this study.

GFP_CDS without intron
ECWT1 and ECWT2
```
Allele 1: wild-type gene
Allele 2: wild-type gene
```
Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtggaactggatggtgatgtgaacgggcacaagttctccgtcagcggaga
gggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccactt
tcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaagaa
aggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaagg
tatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaaga
acggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcgat
ggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgga
gttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga

```
atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtggaactggatggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gatgtgaaccgggcacaagttctccgtcagcggagagggtgaaggtgatgccacctacgga
 D   V   N   G   H   K   F   S   V   S   G   E   G   E   G   D   A   T   Y   G
aagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctc
 K   L   T   L   K   F   I   C   T   T   G   K   L   P   V   P   W   P   T   L
gtcaccactttcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcag
 V   T   T   F   T   Y   G   V   Q   C   F   S   R   Y   P   D   H   M   K   Q
catgacttcttcaagagcgccatgcccgaaggctacgtgcaagaaaggactatcttcttc
 H   D   F   F   K   S   A   M   P   E   G   Y   V   Q   E   R   T   I   F   F
aaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtg
 K   D   D   G   N   Y   K   T   R   A   E   V   K   F   E   G   D   T   L   V
aaccgcatcgagctgaaaggtatcgatttcaaggaagatggaaacatcctcggacacaag
 N   R   I   E   L   K   G   I   D   F   K   E   D   G   N   I   L   G   H   K
ctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaagaacggc
 L   E   Y   N   Y   N   S   H   N   V   Y   I   M   A   D   K   Q   K   N   G
atcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggac
 I   K   V   N   F   K   I   R   H   N   I   E   D   G   S   V   Q   L   A   D
cactaccagcagaacacgcccatcggcgatggccctgtcctgctgccggacaaccattac
 H   Y   Q   Q   N   T   P   I   G   D   G   P   V   L   L   P   D   N   H   Y
ctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctg
 L   S   T   Q   S   A   L   S   K   D   P   N   E   K   R   D   H   M   V   L
ctggagttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga
 L   E   F   V   T   A   A   G   I   T   H   G   M   D   E   L   Y   K   -
```

EC1 co-transforming event: monoallelic
```
Allele 1: deletion of G
```
Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtggaactggatggtgat**G**tgaacgggcacaagttctccgtcagcggaga
gggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccactt
tcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaagaa
aggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaagg
tatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaaga
acggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcgat
ggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgga
gttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga

```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gat tga acg ggc aca agt tct ccg tca gcg gag agg gtg aag gtg atg cca cct acg gaa
 D   -   T   G   T   S   S   P   S   A   E   R   V   K   V   M   P   P   T   E
agc tca ccc tga agt tca tct gca cta ccg gaa agc tcc ctg ttc cgt ggc caa ccc tcg
 S   S   P   -   S   S   S   A   L   P   E   S   S   L   F   R   G   Q   P   S
tca cca ctt tca cct acg gtg ttc agt gct tct ccc ggt acc cag atc aca tga agc agc
 S   P   L   S   P   T   V   F   S   A   S   P   G   T   Q   I   T   -   S   S
atg act tct tca aga gcg cca tgc ccg aag gct acg tgc aag aaa gga cta tct tct tca
 M   T   S   S   R   A   P   C   P   K   A   T   C   K   K   G   L   S   S   S
agg atg acg gga act aca aga cac gtg ccg aag tca agt tcg aag gtg ata ccc tgg tga
 R   M   T   G   T   T   R   H   V   P   K   S   S   S   K   V   I   P   W   -
acc gca tcg agc tga aag gta tcg att tca agg aag atg gaa aca tcc tcg gac aca agc
 T   A   S   S   -   K   V   S   I   S   R   K   M   E   T   S   S   D   T   S
tgg agt aca act aca act ccc aca acg tat aca tca tgg ccg aca agc aga aga acg gca
 W   S   T   T   T   T   P   T   T   Y   T   S   W   P   T   S   R   R   T   A
tca agg tga act tca aga tca ggc aca aca tcg aag atg gaa gcg tgc aac tgg cgg acc
 S   R   -   T   S   R   S   G   T   T   S   K   M   E   A   C   N   W   R   T
act acc agc aga aca cgc cca tcg gcg atg gcc ctg tcc tgc tgc cgg aca acc att acc
 T   T   S   R   T   R   P   S   A   M   A   L   S   C   C   R   T   T   I   T
```

```
tgt cca cgc aat ctg ccc tct cca agg acc cca acg aga aga ggg acc aca tgg tcc tgc
 C   P   R   N   L   P   S   P   R   T   P   T   R   R   G   T   T   W   S   C
tgg agt tcg tga cgg ctg ctg gga tca cgc atg gca tgg atg aac tct aca agt
 W   S   S   -   R   L   L   G   S   R   M   A   W   M   N   S   T   S
```

Allele 2: no *indels*

```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gat gtg aac ggg cac aag ttc tcc gtc agc gga gag ggt gaa ggt gat gcc acc tac gga
 D   V   N   G   H   K   F   S   V   S   G   E   G   E   G   D   A   T   Y   G
aag ctc acc ctg aag ttc atc tgc act acc gga aag ctc cct gtt ccg tgg cca acc ctc
 K   L   T   L   K   F   I   C   T   T   G   K   L   P   V   P   W   P   T   L
gtc acc act ttc acc tac ggt gtt cag tgc ttc tcc cgg tac cca gat cac atg aag cag
 V   T   T   F   T   Y   G   V   Q   C   F   S   R   Y   P   D   H   M   K   Q
cat gac ttc ttc aag agc gcc atg ccc gaa ggc tac gtg caa gaa agg act atc ttc ttc
 H   D   F   F   K   S   A   M   P   E   G   Y   V   Q   E   R   T   I   F   F
aag gat gac ggg aac tac aag aca cgt gcc gaa gtc aag ttc gaa ggt gat acc ctg gtg
 K   D   D   G   N   Y   K   T   R   A   E   V   K   F   E   G   D   T   L   V
aac cgc atc gag ctg aaa ggt atc gat ttc aag gaa gat gga aac atc ctc gga cac aag
 N   R   I   E   L   K   G   I   D   F   K   E   D   G   N   I   L   G   H   K
ctg gag tac aac tac aac tcc cac aac gta tac atc atg gcc gac aag cag aag aac ggc
 L   E   Y   N   Y   N   S   H   N   V   Y   I   M   A   D   K   Q   K   N   G
atc aag gtg aac ttc aag atc agg cac aac atc gaa gat gga agc gtg caa ctg gcg gac
 I   K   V   N   F   K   I   R   H   N   I   E   D   G   S   V   Q   L   A   D
cac tac cag cag aac acg ccc atc ggc gat ggc cct gtc ctg ctg ccg gac aac cat tac
 H   Y   Q   Q   N   T   P   I   G   D   G   P   V   L   L   P   D   N   H   Y
ctg tcc acg caa tct gcc ctc tcc aag gac ccc aac gag aag agg gac cac atg gtc ctg
 L   S   T   Q   S   A   L   S   K   D   P   N   E   K   R   D   H   M   V   L
ctg gag ttc gtg acg gct gct ggg atc acg cat ggc atg gat gaa ctc tac aag tga
 L   E   F   V   T   A   A   G   I   T   H   G   M   D   E   L   Y   K   -
```

EC2 co-transforming event: biallelic
Allele 1: insertion of A

```
Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtg==gaactggatggtgatg**A**tgaa==cgg==gcacaagttctccgtcagcggag
agggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccact
ttcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaaga
aaggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaag
gtatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaag
aacggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcga
tggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgg
agttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga
```

```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gat gat gaa cgg gca caa gtt ctc cgt cag cgg aga ggg tga agg tga tgc cac cta cgg
 D   D   E   R   A   Q   V   L   R   Q   R   R   G   -   R   -   C   H   L   R
aaa gct cac cct gaa gtt cat ctg cac tac cgg aaa gct ccc tgt tcc gtg gcc aac cct
 K   A   H   P   E   V   H   L   H   Y   R   K   A   P   C   S   V   A   N   P
cgt cac cac ttt cac cta cgg tgt tca gtg ctt ctc ccg gta ccc aga tca cat gaa gca
 R   H   H   F   H   L   R   C   S   V   L   L   P   V   P   R   S   H   E   A
gca tga ctt ctt caa gag cgc cat gcc cga agg cta cgt gca aga aag gac tat ctt ctt
 A   -   L   L   Q   E   R   H   A   R   R   L   R   A   R   K   D   Y   L   L
caa gga tga cgg gaa cta caa gac acg tgc cga agt caa gtt cga agg tga tac cct ggt
 Q   G   -   R   E   L   Q   D   T   C   R   S   Q   V   R   R   -   Y   P   G
gaa ccg cat cga gct gaa agg tat cga ttt caa gga aga tgg aaa cat cct cgg aca caa
 E   P   H   R   A   E   R   Y   R   F   Q   G   R   W   K   H   P   R   T   Q
gct gga gta caa cta caa ctc cca caa cgt ata cat cat ggc cga caa gca gaa gaa cgg
 A   G   V   Q   L   Q   L   P   Q   R   I   H   H   G   R   Q   A   E   E   R
cat caa ggt gaa ctt caa gat cag gca caa cat cga aga tgg aag cgt gca act ggc gga
 H   Q   G   E   L   Q   D   Q   A   Q   H   R   D   W   S   V   Q   L   A   D
cca cta cca gca gaa cac gcc cat cgg cga tgg ccc tgt cct gct gcc gga caa cca tta
 P   L   P   A   E   H   A   H   R   R   W   P   C   P   A   A   G   Q   P   L
cct gtc cac gca atc tgc cct ctc caa gga ccc caa cga gaa gag gga cca cat ggt cct
 P   V   H   A   I   C   P   L   Q   G   P   Q   R   E   E   G   P   H   G   P
gct gga gtt cgt gac ggc tgc tgg gat cac gca tgg cat gga tga act cta caa gtg
 A   G   V   R   D   G   C   W   D   H   A   W   H   G   -   T   L   Q   V
```

Allele 2: deletion of GA

```
Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtg==gaactggatggtgatgt**GA**gaa==cgg==gcacaagttctccgtcagcgg
agagggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcacca
ctttcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaa
gaaaggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaa
aggtatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcaga
gaacggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggc
gatggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgct
ggagttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga
```

```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gat gtg aga acg ggc aca agt tct ccg tca gcg gag agg gtg aag gtg atg cca cct acg
 D   V   R   T   G   T   S   S   P   S   A   E   R   V   K   V   M   P   P   T
gaa agc tca ccc tga agt tca tct gca cta ccg gaa agc tcc ctg ttc cgt ggc caa ccc
 E   S   S   P   -   S   S   S   A   L   P   E   S   S   L   F   R   G   Q   P
tcg tca cca ctt tca cct acg gtg ttc agt gct tct ccc ggt acc cag atc aca tga agc
 S   S   P   L   S   P   T   V   F   S   A   S   P   G   T   Q   I   T   -   S
agc atg act tct tca aga gcg cca tgc ccg aag gct acg tgc aag aaa gga cta tct tct
 S   M   T   S   S   R   A   P   C   P   K   A   T   C   K   K   G   L   S   S
tca agg atg acg gga act aca aga cac gtg ccg aag tca agt tcg aag gtg ata ccc tgg
 S   R   M   T   G   T   T   R   H   V   P   K   S   S   S   K   V   I   P   W
tga acc gca tcg agc tga aag gta tcg att tca agg aag atg gaa aca tcc tcg gac aca
 -   T   A   S   S   -   K   V   S   I   S   R   K   M   E   T   S   S   D   T
agc tgg agt aca act aca act ccc aca acg tat aca tca tgg ccg aca agc aga aga acg
 S   W   S   T   T   T   T   P   T   T   Y   T   S   W   P   T   S   R   R   T
gca tca agg tga act tca aga tca ggc aca aca tcg aag atg gaa gcg tgc aac tgg cgg
 A   S   R   -   T   S   R   S   G   T   T   S   K   M   E   A   C   N   W   R
acc act acc agc aga aca cgc cca tcg gcg atg gcc ctg tcc tgc tgc cgg aca acc att
 T   T   T   S   R   T   R   P   S   A   M   A   L   S   C   C   R   T   T   I
acc tgt cca cgc aat ctg ccc tct cca agg acc cca acg aga aga ggg acc aca tgg tcc
 T   C   P   R   N   L   P   S   P   R   T   P   T   R   R   G   T   T   W   S
tgc tgg agt tcg tga cgg ctg ctg gga tca cgc atg gca tgg atg aac tct aca agt
 C   W   S   S   -   R   L   L   G   S   R   M   A   W   M   N   S   T   S
```

EC3 co-transforming event: biallelic

Allele 1: deletion of ATGT

Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtggaactggatggtg**ATGT**gaacggcacaagttctccgtcagcggag
aggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccact
ttcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaaga
aaggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaag
gtatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaag
aacggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcga
tggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgg
agttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga

```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gga acg ggc aca agt tct ccg tca gcg gag agg gtg aag gtg atg cca cct acg gaa agc
 G   T   G   T   S   S   P   S   A   E   R   V   K   V   M   P   P   T   E   S
tca ccc tga agt tca tct gca cta ccg gaa agc tcc ctg ttc cgt ggc caa ccc tcg tca
 S   P   -   S   S   S   A   L   P   E   S   S   L   F   R   G   Q   P   S   S
cca ctt tca cct acg gtg ttc agt gct tct ccc ggt acc cag atc aca tga agc agc atg
 P   L   S   P   T   V   F   S   A   S   P   G   T   Q   I   T   -   S   S   M
act tct tca aga gcg cca tgc ccg aag gct acg tgc aag aaa gga cta tct tct tca agg
 T   S   S   R   A   P   C   P   K   A   T   C   K   K   G   L   S   S   S   R
atg acg gga act aca aga cac gtg ccg aag tca agt tcg aag gtg ata ccc tgg tga acc
 M   T   G   T   T   R   H   V   P   K   S   S   S   K   V   I   P   W   -   T
gca tcg agc tga aag gta tcg att tca agg aag atg gaa aca tcc tcg gac aca agc tgg
 A   S   S   -   K   V   S   I   S   R   K   M   E   T   S   S   D   T   S   W
agt aca aca act ccc aca acg tat aca tca tgg ccg aca agc aga aga acg gca tca
 S   T   T   T   P   T   T   Y   T   S   W   P   T   S   R   R   T   A   S
agg tga act tca aga tca ggc aca aca tcg aag atg gaa gcg tgc aac tgg cgg acc act
 R   -   T   S   R   S   G   T   T   S   K   M   E   A   C   N   W   R   T   T
acc agc aga aca cgc cca tcg gcg atg gcc ctg tcc tgc tgc cgg aca acc att acc tgt
 T   S   R   T   R   P   S   A   M   A   L   S   C   C   R   T   T   I   T   C
cca cgc aat ctg ccc tct cca agg acc cca acg aga aga ggg acc aca tgg tcc tgc tgg
 P   R   N   L   P   S   P   R   T   P   T   R   R   G   T   T   W   S   C   W
agt tcg tga cgg ctg ctg gga tca cgc atg gca tgg atg aac tct aca agt
 S   S   -   R   L   L   G   S   R   M   A   W   M   N   S   T   S
```

Allele 2: two deletions of G

Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtggaactg**G**at**G**gtgatgtgaacggcacaagttctccgtcagcggag
aggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccact
ttcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaaga
aaggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaag
gtatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaag
aacggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcga
tggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgg
agttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga
```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg atg tga
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   M   -
tgt gaa gca caa gtt ctc cgt cag cgg aga ggg tga agg tga tgc cac cta cgg aaa
 C   E   R   Q   V   L   R   Q   R   R   G   -   R   -   C   H   L   R   K
gct cac cct gaa gtt cat ctg cac tac cgg aaa gct ccc tgt cgt gtg gcc aac cct cgt
 A   H   P   E   V   H   L   H   Y   R   K   A   P   C   S   V   A   N   P   R
cac cac ttt cac cta cgg tgt tca gtg ctt ctc ccg gta ccc aga tca cat gaa gca gca
 H   H   F   H   L   R   C   S   V   L   L   P   V   P   R   S   H   E   A   A
```

```
tga ctt ctt caa gag cgc cat gcc cga agg cta cgt gca aga aag gac tat ctt ctt caa
 -   L   L   Q   E   R   H   A   R   R   L   R   A   R   K   D   Y   L   L   Q
gga tga cgg gaa cta caa gac acg tgc cga agt caa gtt cga agg tga tac cct ggt gaa
 G   -   R   E   L   Q   D   T   C   R   S   Q   V   R   R   -   Y   P   G   E
ccg cat cga gct gaa agg tat cga ttt caa gga aga tgg aaa cat cct cgg aca caa gct
 P   H   R   A   E   R   Y   R   F   Q   G   R   W   K   H   P   R   T   Q   A
gga gta caa cta caa ctc cca caa cgt ata cat cat ggc cga caa gca gaa gaa cgg cat
 G   V   Q   L   Q   L   P   Q   R   I   H   H   G   R   Q   A   E   E   R   H
caa ggt gaa ctt cca gat cag gca caa cat cga aga tgg aag cgt gca act ggc gga cca
 Q   G   E   L   Q   D   Q   A   Q   H   R   R   W   K   R   A   T   G   G   P
cta cca gca gaa cac gcc cat cgg cga tgg ccc tgt cct gct gcc gga caa cca tta cct
 L   P   A   E   H   A   H   R   R   W   P   C   P   A   A   G   Q   P   L   P
gtc cac gca atc tgc cct ctc caa gga ccc caa cga gaa gag gga cca cat ggt cct gct
 V   H   A   I   C   P   L   Q   G   P   Q   R   E   E   G   P   H   G   P   A
gga gtt cgt gac ggc tgc tgg gat cac gca tgg cat gga tga act cta caa gtg
 G   V   R   D   G   C   W   D   H   A   W   H   G   -   T   L   Q   V
```

EC4 co-transforming event: biallelic
Allele 1: deletion of G

Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtg<mark style="background:yellow">gaactggatggtgat**G**</mark><mark style="background:magenta">tgaa</mark><mark style="background:magenta">cgg</mark>gcacaagttctccgtcagcggaga
gggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccactt
tcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaagaa
aggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaagg
tatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaaga
acggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcgat
ggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgga
gttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga

```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gat tga acg ggc aca agt tct ccg tca gcg gag agg gtg aag gtg atg cca cct acg gaa
 D   -   T   G   T   S   S   P   S   A   E   R   V   K   V   M   P   P   T   E
agc tca ccc tga agt tca tct gca cta ccg gaa agc tcc ctg ttc cgt ggc caa ccc tcg
 S   S   P   -   S   S   S   A   L   P   E   S   S   L   F   R   G   Q   P   S
tca cca ctt tca cct acg gtg ttc agt gct tct ccc ggt acc cag atc aca tga agc agc
 S   P   L   S   P   T   V   F   S   A   S   P   G   T   Q   I   T   -   S   S
atg act tct tca aga gcg cca tgc cct aag gct acg tgc aag aaa gga cta tct tct tca
 M   T   S   S   R   A   P   C   P   K   A   T   C   K   K   G   L   S   S   S
agg atg acg gga act aca aga cac gtg ccg aag tca agt tcg aag gtg ata ccc tgg tga
 R   M   T   G   T   T   R   H   V   P   K   S   S   S   K   V   I   P   W   -
acc gca tcg agc tga aag gta tcg att tca agg aag atg gaa aca tcc tcg gac aca agc
 T   A   S   S   -   K   V   S   I   S   R   K   M   E   T   S   S   D   T   S
tgg agt aca act aca act ccc aca acg tat aca tca tgg ccg aca agc aga aga acg gca
 W   S   T   T   T   T   P   T   T   Y   T   S   W   P   T   S   R   R   T   A
tca agg tga act tca aga tca ggc aca aca tcg aag atg gaa gcg tgc aac tgg cgg acc
 S   R   -   T   S   R   S   G   T   T   S   K   M   E   A   C   N   W   R   T
act acc agc aga aca cgc cca tcg gcg atg gcc ctg tcc tgc tgc cgg aca acc att acc
 T   T   S   R   T   R   P   S   A   M   A   L   S   C   C   R   T   T   I   T
tgt cca cgc aat ctg ccc tct cca agg acc cca acg aga aga ggg acc aca tgg tcc tgc
 C   P   R   N   L   P   S   P   R   T   P   R   R   G   T   T   W   S   C
tgg agt tcg tga cgg ctg ctg gga tca cgc atg gca tgg atg aac tct aca agt
 W   S   S   -   R   L   L   G   S   R   M   A   W   M   N   S   T   S
```

Allele 2: insertion of A

Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtg<mark style="background:yellow">gaactggatggtgatgt**A**</mark><mark style="background:magenta">gaa</mark><mark style="background:magenta">cgg</mark>gcacaagttctccgtcagcggag
agggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccact
ttcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaaga
aaggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaag
gtatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaag
aacggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcga
tggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgg
agttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga

```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gat gta gaa cgg gca caa gtt ctc cgt cag cgg aga ggg tga agg tga tgc cac cta cgg
 D   V   E   R   A   Q   V   L   R   Q   R   R   G   -   R   -   C   H   L   R
aaa gct cac cct gaa gtt cat ctg cac tac cgg aaa gct ccc tgt tcc gtg gcc aac cct
 K   A   H   P   E   V   H   L   H   Y   R   K   A   P   C   S   V   A   N   P
cgt cac cac ttt cac cta cgg tgt tca gtg ctt ctc ccg gta ccc aga tca cat gaa gca
 R   H   H   F   H   L   R   C   S   V   L   L   P   V   P   R   S   H   E   A
gca tga ctt ctt caa gag cgc cat gcc cga agg cta cgt gca aga aag gac tat ctt ctt
 A   -   L   L   Q   E   R   H   A   R   R   L   R   A   R   K   D   Y   L   L
caa gga tga cgg gaa cta caa gac acg tgc cga agt caa gtt cga agg tga tac cct ggt
 Q   G   -   R   E   L   Q   D   T   C   R   S   Q   V   R   R   -   Y   P   G
gaa ccg cat cga gct gaa agg tat cga ttt caa gga aga tgg aaa cat cct cgg aca caa
 E   P   H   R   A   E   R   Y   R   F   Q   G   R   W   K   H   P   R   T   Q
gct gga gta caa cta caa ctc cca caa cgt ata cat cat ggc cga caa gca gaa gaa cgg
```

```
      A    G    V    Q    L    Q    L    P    Q    R    I    H    H    G    R    Q    A    E    E    R
     cat  caa  ggt  gaa  ctt  caa  gat  cag  gca  caa  cat  cga  aga  tgg  aag  cgt  gca  act  ggc  gga
      H    Q    G    E    L    Q    D    Q    A    Q    H    R    R    W    K    R    A    T    G    G
     cca  cta  cca  gca  gaa  cac  gcc  cat  cgg  cga  tgg  ccc  tgt  cct  gct  gcc  gga  caa  cca  tta
      P    L    P    A    E    H    A    H    R    R    W    P    C    P    A    A    G    Q    P    L
     cct  gtc  cac  gca  atc  tgc  cct  ctc  caa  gga  ccc  caa  cga  gaa  gag  gga  cca  cat  ggt  cct
      P    V    H    A    I    C    P    L    Q    G    P    Q    R    E    E    G    P    H    G    P
     gct  gga  gtt  cgt  gac  ggc  tgc  tgg  gat  cac  gca  tgg  cat  gga  tga  act  cta  caa  gtg
      A    G    V    R    D    G    C    W    D    H    A    W    H    G    -    T    L    Q    V
```

EC5 co-transforming event: biallelic
Allele 1: deletion of G

Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtg==gaactggatggtgat**G**tgaa==`cgg`gcacaagttctccgtcagcggaga
gggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttcctgttcctgttggccaaccctcgtcaccactt
tcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaagaa
aggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaagg
tatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaaga
acggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcgat
ggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgga
gttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga

```
    atg  ggc  aag  ggc  gag  gaa  ctg  ttc  act  ggc  gtg  gtc  cca  atc  ctg  gtg  gaa  ctg  gat  ggt
     M    G    K    G    E    E    L    F    T    G    V    V    P    I    L    V    E    L    D    G
    gat  tga  acg  ggc  aca  agt  tct  ccg  tca  gcg  gag  agg  gtg  aag  gtg  atg  cca  cct  acg  gaa
     D    -    T    G    T    S    S    P    S    A    E    R    V    K    V    M    P    P    T    E
    agc  tca  ccc  tga  agt  tca  tct  gca  cta  ccg  gaa  agc  tcc  ctg  ttc  cgt  ggc  caa  ccc  tcg
     S    S    P    -    S    S    S    A    L    P    E    S    S    L    F    R    G    Q    P    S
    tca  cca  ctt  tca  cct  acg  gtg  ttc  agt  gct  tct  ccc  ggt  acc  cag  atc  aca  tga  agc  agc
     S    P    L    S    P    T    V    F    S    A    S    P    G    T    Q    I    T    -    S    S
    atg  act  tct  tca  aga  gcg  cca  tgc  ccg  aag  gct  acg  tgc  aag  aaa  gga  cta  tct  tct  tca
     M    T    S    S    R    A    P    C    P    K    A    T    C    K    K    G    L    S    S    S
    agg  atg  acg  gga  act  aca  aga  cac  gtg  ccg  aag  tca  agt  tcg  aag  gtg  ata  ccc  tgg  tga
     R    M    T    G    T    T    R    H    V    P    K    S    S    K    V    I    P    W    -
    acc  gca  tcg  agc  tga  aag  gta  tcg  att  tca  agg  aag  atg  gaa  aca  tcc  tcg  gac  aca  agc
     T    A    S    S    -    K    V    S    I    S    R    K    M    E    T    S    S    D    T    S
    tgg  agt  aca  act  aca  act  ccc  aca  acg  tat  aca  tca  tgg  ccg  aca  agc  aga  aga  acg  gca
     W    S    T    T    T    T    P    T    T    Y    T    S    W    P    T    S    R    R    T    A
    tca  agg  tga  act  tca  aga  tca  ggc  aca  aca  tcg  aag  atg  gaa  gcg  tgc  aac  tgg  cgg  acc
     S    R    -    T    S    R    S    G    T    T    S    K    M    E    A    C    N    W    R    T
    act  acc  agc  aga  aca  cgc  cca  tcg  gcg  atg  gcc  ctg  tcc  tgc  tgc  cgg  aca  acc  att  acc
     T    T    S    R    T    R    P    S    A    M    A    L    S    C    C    R    T    T    I    T
    tgt  cca  cgc  aat  ctg  ccc  tct  cca  agg  acc  cca  acg  aga  aga  ggg  acc  aca  tgg  tcc  tgc
     C    P    R    N    L    P    S    P    R    T    P    T    R    R    G    T    T    W    S    C
    tgg  agt  tcg  tga  cgg  ctg  ctg  gga  tca  cgc  atg  gca  tgg  atg  aac  tct  aca  agt
     W    S    S    -    R    L    L    G    S    R    M    A    W    M    N    S    T    S
```

Allele 2: deletions of GT

Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtg==gaactggatggtgat**GT**gaa==`cgg`gcacaagttctccgtcagcggag
agggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccact
ttcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaaga
aaggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaag
gtatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaag
aacggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcga
tggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgg
agttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga

```
    atg  ggc  aag  ggc  gag  gaa  ctg  ttc  act  ggc  gtg  gtc  cca  atc  ctg  gtg  gaa  ctg  gat  ggt
     M    G    K    G    E    E    L    F    T    G    V    V    P    I    L    V    E    L    D    G
    gat  gaa  cgg  gca  caa  gtt  ctc  cgt  cag  cgg  aga  ggg  tga  agg  tga  tgc  cac  cta  cgg  aaa
     D    E    R    A    Q    V    L    R    Q    R    R    G    -    R    -    C    H    L    R    K
    gct  cac  cct  gaa  gtt  cat  ctg  cac  tac  cgg  aaa  gct  ccc  tgt  tcc  gtg  gcc  aac  cct  cgt
     A    H    P    E    V    H    L    H    Y    R    K    A    P    C    S    V    A    N    P    R
    cac  cac  ttt  cac  cta  cgg  tgt  tca  gtg  ctt  ctc  ccg  gta  ccc  aga  tca  cat  gaa  gca  gca
     H    H    F    H    L    R    C    S    V    L    L    P    V    P    R    S    H    E    A    A
    tga  ctt  ctt  caa  gag  cgc  cat  gcc  cga  agg  cta  cgt  gca  aga  aag  gac  tat  ctt  ctt  caa
     -    L    L    Q    E    R    H    A    R    R    L    R    A    R    K    D    Y    L    L    Q
    gga  tga  cgg  gaa  cta  caa  gac  acg  tgc  cga  agt  caa  gtt  cga  agg  tga  tac  cct  ggt  gaa
     G    -    R    E    L    Q    D    T    C    R    S    Q    V    R    R    -    Y    P    G    E
    ccg  cat  cga  gct  gaa  agg  tat  cga  ttt  caa  gga  aga  tgg  aaa  cat  cct  cgg  aca  caa  gct
     P    H    R    A    E    R    Y    R    F    Q    G    R    W    K    H    P    R    T    Q    A
    gga  gta  caa  cta  caa  ctc  cca  caa  cgt  ata  cat  cat  ggc  cga  caa  gca  gaa  gaa  cgg  cat
     G    V    Q    L    Q    L    P    Q    R    I    H    H    G    R    Q    A    E    E    R    H
    caa  ggt  gaa  ctt  caa  gat  cag  gca  caa  cat  cga  aga  tgg  aag  cgt  gca  act  ggc  gga  cca
     Q    G    E    L    Q    D    Q    A    Q    H    R    R    W    K    R    A    T    G    G    P
    cta  cca  gca  gaa  cac  gcc  cat  cgg  cga  tgg  ccc  tgt  cct  gct  gcc  gga  caa  cca  tta  cct
     L    P    A    E    H    A    H    R    R    W    P    C    P    A    A    G    Q    P    L    P
    gtc  cac  gca  atc  tgc  cct  ctc  caa  gga  ccc  caa  cga  gaa  gag  gga  cca  cat  ggt  cct  gct
     V    H    A    I    C    P    L    Q    G    P    Q    R    E    E    G    P    H    G    P    A
```

```
gga gtt cgt gac ggc tgc tgg gat cac gca tgg cat gga tga act cta caa gtg
 G   V   R   D   G   C   W   D   H   A   W   H   G   -   T   L   Q   V
```

EC6 co-transforming event: biallelic
Allele 1: deletion of TG

Atgggcaaggycgaggaactgttcactggcgtggtcccaatcctggtg==gaactggatggtgatg**TG**aa==`cgg`gcacaagttctccgtcagcggag
aggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccact
ttcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaaga
aaggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaag
gtatcgatttcaaggaagatggaaacatcctcggcacaagctggagtacaactacaactcccacaacgtatacatcatgggccgacaagcagaga
aacggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcga
tggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctcctccaaggaccccaacgagaagagggaccacatggtcctgctgg
agttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga

```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gat gaa cgg gca caa gtt ctc cgt cag cgg aga ggg tga tga tgc cac cta cgg aaa
 D   E   R   A   Q   V   L   R   Q   R   R   G   -   R   -   C   H   L   R   K
gct cac cct gaa gtt cat ctg cac tac cgg aaa gct ccc tgt tcc gtg gcc aac cct cgt
 A   H   P   E   V   H   L   H   Y   R   K   A   P   C   S   V   A   N   P   R
cac cac ttt cac cta cgg tgt tca gtg ctt ctc ccg gta ccc aga tca cat gaa gca gca
 H   H   F   H   L   R   C   S   V   L   L   P   V   P   R   S   H   E   A   A
tga ctt ctt caa gag cgc cat gcc cga agg cta cgt gca aga aag gac tat ctt ctt caa
 -   L   L   Q   E   R   H   A   R   R   L   R   A   R   K   D   Y   L   L   Q
gga tga cgg gaa cta caa gac acg tgc cga agt caa gtt cga agg tga tac cct ggt gaa
 G   -   R   E   L   Q   D   T   C   R   S   Q   V   R   R   -   Y   P   G   E
ccg cat cga gct gaa agg tat cga ttt caa gga aga tgg aaa cat cct cgg aca caa gct
 P   H   R   A   E   R   Y   R   F   Q   G   R   W   K   H   P   R   T   Q   A
gga gta caa cta caa ctc cca caa cgt ata cat cat ggc cga caa gca gaa gaa cgg cat
 G   V   Q   L   Q   L   P   Q   R   I   H   H   G   R   Q   A   E   E   R   H
caa ggt gaa ctt caa gat cag gca caa cat cga aga tgg aag cgt gca act ggc gga cca
 Q   G   E   L   Q   D   Q   A   Q   H   R   R   W   K   R   A   T   G   G   P
cta cca gca gaa cac gcc cat cgg cga tgg ccc tgt cct gct gcc gga caa cca tta cct
 L   P   A   E   H   A   H   R   R   W   P   C   P   A   A   G   Q   P   L   P
gtc cac gca atc tgc cct ctc caa gga ccc caa cga gaa gag gga cca cat ggt cct gct
 V   H   A   I   C   P   L   Q   G   P   Q   R   E   E   G   P   H   G   P   A
gga gtt cgt gac ggc tgc tgg gat cac gca tgg cat gga tga act cta caa gtg
 G   V   R   D   G   C   W   D   H   A   W   H   G   -   T   L   Q   V
```

Allele 2: insertion of T

Atgggcaaggycgaggaactgttcactggcgtggtcccaatcctggtg==gaactggatggtgatg**T**tgaa==`cgg`gcacaagttctccgtcagcggag
aggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccact
ttcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaaga
aaggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaag
gtatcgatttcaaggaagatggaaacatcctcggcacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaag
aacggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcga
tggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctcctccaaggaccccaacgagaagagggaccacatggtcctgctgg
agttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga

```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gat gtt gaa cgg gca caa gtt ctc cgt cag cgg aga ggg tga agg tga tgc cac cta cgg
 D   V   E   R   A   Q   V   L   R   Q   R   R   G   -   R   -   C   H   L   R
aaa gct cac cct gaa gtt cat ctg cac tac cgg aaa gct ccc tgt tcc gtg gcc aac cct
 K   A   H   P   E   V   H   L   H   Y   R   K   A   P   C   S   V   A   N   P
cgt cac cac ttt cac cta cgg tgt tca gtg ctt ctc ccg gta ccc aga tca cat gaa gca
 R   H   H   F   H   L   R   C   S   V   L   L   P   V   P   R   S   H   E   A
gca tga ctt ctt caa gag cgc cat gcc cga agg cta cgt gca aga aag gac tat ctt ctt
 A   -   L   L   Q   E   R   H   A   R   R   L   R   A   R   K   D   Y   L   L
caa gga tga cgg gaa cta caa gac acg tgc cga agt caa gtt cga agg tga tac cct ggt
 Q   G   -   R   E   L   Q   D   T   C   R   S   Q   V   R   R   -   Y   P   G
gaa ccg cat cga gct gaa agg tat cga ttt caa gga aga tgg aaa cat cct cgg aca caa
 E   P   H   R   A   E   R   Y   R   F   Q   G   R   W   K   H   P   R   T   Q
gct gga gta caa cta caa ctc cca caa cgt ata cat cat ggc cga caa gca gaa gaa cgg
 A   G   V   Q   L   Q   L   P   Q   R   I   H   H   G   R   Q   A   E   E   R
cat caa ggt gaa ctt caa gat cag gca caa cat cga aga tgg aag cgt gca act ggc gga
 H   Q   G   E   L   Q   D   Q   A   Q   H   R   R   W   K   R   A   T   G   G
cca cta cca gca gaa cac gcc cat cgg cga tgg ccc tgt cct gct gcc gga caa cca tta
 P   L   P   A   E   H   A   H   R   R   W   P   C   P   A   A   G   Q   P   L
cct gtc cac gca atc tgc cct ctc caa gga ccc caa cga gaa gag gga cca cat ggt cct
 P   V   H   A   I   C   P   L   Q   G   P   Q   R   E   E   G   P   H   G   P
gct gga gtt cgt gac ggc tgc tgg gat cac gca tgg cat gga tga act cta caa gtg
 A   G   V   R   D   G   C   W   D   H   A   W   H   G   -   T   L   Q   V
```

EC7 co-transforming event: monoallelic
Allele 1: no indels
Atgggcaaggycgaggaactgttcactggcgtggtcccaatcctggtg==gaactggatggtgatgtgaa==`cgg`gcacaagttctccgtcagcggaga
gggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccactt

```
tcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaagaa
aggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaagg
tatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaaga
acggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcgat
ggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgga
gttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga
```

```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gat gtg aac ggg cac aag ttc tcc gtc agc gga gag ggt gaa ggt gat gcc acc tac gga
 D   V   N   G   H   K   F   S   V   S   G   E   G   E   G   D   A   T   Y   G
aag ctc acc ctg aag ttc atc tgc act acc gga aag ctc cct gtt ccg tgg cca acc ctc
 K   L   T   L   K   F   I   C   T   T   G   K   L   P   V   P   W   P   T   L
gtc acc act ttc acc tac ggt gtt cag tgc ttc tcc cgg tac cca gat cac atg aag cag
 V   T   T   F   T   Y   G   V   Q   C   F   S   R   Y   P   D   H   M   K   Q
cat gac ttc ttc aag agc gcc atg ccc gaa ggc tac gtg caa gaa agg act atc ttc ttc
 H   D   F   F   K   S   A   M   P   E   G   Y   V   Q   E   R   T   I   F   F
aag gat gac ggg aac tac aag aca cgt gcc gaa gtc aag ttc gaa ggt gat acc ctg gtg
 K   D   D   G   N   Y   K   T   R   A   E   V   K   F   E   G   D   T   L   V
aac cgc atc gag ctg aaa ggt atc gat ttc aag gaa gat gga aac atc ctc gga cac aag
 N   R   I   E   L   K   G   I   D   F   K   E   D   G   N   I   L   G   H   K
ctg gag tac aac tac aac tcc cac aac gta tac atc atg gcc gac aag cag aag aac ggc
 L   E   Y   N   Y   N   S   H   N   V   Y   I   M   A   D   K   Q   K   N   G
atc aag gtg aac ttc aag atc agg cac aac atc gaa gat gga agc gtg caa ctg gcg gac
 I   K   V   N   F   K   I   R   H   N   I   E   D   G   S   V   Q   L   A   D
cac tac cag cag aac acg ccc atc ggc gat ggc cct gtc ctg ctg ccg gac aac cat tac
 H   Y   Q   Q   N   T   P   I   G   D   G   P   V   L   L   P   D   N   H   Y
ctg tcc acg caa tct gcc ctc tcc aag gac ccc aac gag aag agg gac cac atg gtc ctg
 L   S   T   Q   S   A   L   S   K   D   P   N   E   K   R   D   H   M   V   L
ctg gag ttc gtg acg gct gct ggg atc acg cat ggc atg gat gaa ctc tac aag tga
 L   E   F   V   T   A   A   G   I   T   H   G   M   D   E   L   Y   K   -
```

Allele 2: deletion of TG

```
AtgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtggaactggatggtgatgTGaacgggcacaagttctccgtcagcggag
aggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccact
ttcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaaga
aaggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaag
gtatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaag
aacggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcga
tggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgg
agttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga
```

```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gat gaa cgg gca caa gtt ctc cgt cag cgg aga ggg tga agg tga tgc cac cta cgg aaa
 D   E   R   A   Q   V   L   R   Q   R   R   G   -   R   -   C   H   L   R   K
gct cac cct gaa gtt cat ctg cac tac cgg aaa gct ccc tgt tcc gtg gcc aac cct cgt
 A   H   P   E   V   H   L   H   Y   R   K   A   P   C   S   V   A   N   P   R
cac cac ttt cac cta cgg tgt tca gtg ctt ctc ccg gta ccc aga tca cat gaa gca gca
 H   H   F   H   L   R   C   S   V   L   L   P   V   P   R   S   H   E   A   A
tga ctt ctt caa gag cgc cat gcc cga agg cta cgt gca aga aag gac tat ctt ctt caa
 -   L   L   Q   E   R   H   A   R   R   L   R   A   R   K   D   Y   L   L   Q
gga tga cgg gaa cta caa gac acg tgc cga agt caa gtt cga agg tga tac cct ggt gaa
 G   -   R   E   L   Q   D   T   C   R   S   Q   V   R   R   -   Y   P   G   E
ccg cat cga gct gaa agg tat cga ttt caa gga aga tgg aaa cat cct cgg aca caa gct
 P   H   R   A   E   R   Y   R   F   Q   G   R   W   K   H   P   R   T   Q   A
gga gta caa cta caa ctc cca caa cgt ata cat cat ggc cga caa gca gaa gaa cgg cat
 G   V   Q   L   Q   L   P   Q   R   I   H   H   G   R   Q   A   E   E   R   H
caa ggt gaa ctt caa gat cag gca caa cat cga aga tgg aag cgt gca act ggc gga cca
 Q   G   E   L   Q   D   Q   A   Q   H   R   R   W   K   R   A   T   G   G   P
cta cca gca gaa cac gcc cat cgg cga tgg ccc tgt cct gct gcc gga caa cca tta cct
 L   P   A   E   H   A   H   R   R   W   P   C   P   A   A   G   Q   P   L   P
gtc cac gca atc tgc cct ctc caa gga ccc caa cga gaa gag gga cca cat ggt cct gct
 V   H   A   I   C   P   L   Q   G   P   Q   R   E   E   G   P   H   G   P   A
gga gtt cgt gac ggc tgc tgg gat cac gca tgg cat gga tga act cta caa gtg
 G   V   R   D   G   C   W   D   H   A   W   H   G   -   T   L   Q   V
```

EC8 co-transforming event: monoallelic
Allele 1: deletion of T

```
AtgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtggaactggatggtgatgTgaacggcacaagttctccgtcagcggaga
gggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaacccctcgtcaccactt
tcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaagaa
aggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaagg
tatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaaga
acggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcgat
ggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgga
gttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga
```

```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gat gga acg ggc aca agt tct ccg tca gcg gag agg gtg aag gtg atg cca cct acg gaa
 D   G   T   G   T   S   S   P   S   A   E   R   V   K   V   M   P   P   T   E
agc tca ccc tga agt tca tct gca cta ccg gaa agc tcc ctg ttc cgt ggc caa ccc tcg
 S   S   P   -   S   S   S   A   L   P   E   S   S   L   F   R   G   Q   P   S
tca cca ctt tca cct acg gtt tca gtg ctt tct ccc ggt acc cag atc aca tga agc agc
 S   P   L   S   P   T   V   F   S   A   S   P   G   T   Q   I   T   -   S   S
atg act tct tca aga gcg cca tgc ccg aag gct acg tgc aag aaa gga cta tct tct tca
 M   T   S   S   R   A   P   C   P   K   A   T   C   K   K   G   L   S   S   S
agg atg acg gga act aca aga cac gtg ccg aag tca agt tcg aag gtg ata ccc tgg tga
 R   M   T   G   T   T   R   H   V   P   K   S   S   S   K   V   I   P   W   -
acc gca tcg agc tga aag gta tcg att tca agg aag atg gaa aca tcc tcg gac aca agc
 T   A   S   S   -   K   V   S   I   S   R   K   M   E   T   S   S   D   T   S
tgg agt aca act aca act ccc aca gta tac atc atg gcc gac aag cag aag aac ggc atc aag gtg
 W   S   T   T   T   P   T   Y   T   S   W   P   T   S   R   R   T   A
tca agg tga act tca aga tca ggc aca aca tcg aag atg gaa gcg tgc aac tgg cgg acc
 S   R   -   T   S   R   S   G   T   T   S   K   M   E   A   C   N   W   R   T
act acc agc aga aca cgc cca tcg gcg atg gcc ctg tcc tgc tgc cgg aca acc att acc
 T   T   S   R   T   R   P   S   A   M   A   L   S   C   C   R   T   T   I   T
tgt cca cgc aat ctg ccc tct cca agg acc cca acg aga gag ggg acc aca tgg tcc tgc
 C   P   R   N   L   P   S   P   R   T   P   T   R   R   G   T   T   W   S   C
tgg agt tcg tga cgg ctg ctg gga tca cgc atg gca tgg atg aac tct aca agt
 W   S   S   -   R   L   L   G   S   R   M   A   W   M   N   S   T   S
```

Allele 2: no indels

Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtg<mark>gaactggatggtgatgtgaa</mark><mark style="background:magenta">cgg</mark>gcacaagttctccgtcagcggaga
gggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccactt
tcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaagaa
aggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaagg
tatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaaga
acggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcgat
ggccctgtcctgctgccggacaaccattaccтgтccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgga
gttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga

```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gat gtg aac ggg cac aag ttc tcc gtc agc gga gag ggt gaa ggt gat gcc acc tac gga
 D   V   N   G   H   K   F   S   V   S   G   E   G   E   G   D   A   T   Y   G
aag ctc acc ctg aag ttc atc tgc act acc gga aag ctc cct gtt ccg tgg cca acc ctc
 K   L   T   L   K   F   I   C   T   T   G   K   L   P   V   P   W   P   T   L
gtc acc act ttc acc tac ggt gtt cag tgc ttc tcc cgg tac cca gat cac atg aag cag
 V   T   T   F   T   Y   G   V   Q   C   F   S   R   Y   P   D   H   M   K   Q
cat gac ttc ttc aag agc gcc atg ccc gaa ggc tac gtg caa gaa agg act atc ttc ttc
 H   D   F   F   K   S   A   M   P   E   G   Y   V   Q   E   R   T   I   F   F
aag gat gac ggg aac tac aag aca cgt gcc gaa gtc aag ttc gaa ggt gat acc ctg gtg
 K   D   D   G   N   Y   K   T   R   A   E   V   K   F   E   G   D   T   L   V
aac cgc atc gag ctg aaa ggt atc gat ttc aag gaa gat gga aac atc ctc gga cac aag
 N   R   I   E   L   K   G   I   D   F   K   E   D   G   N   I   L   G   H   K
ctg gag tac aac tac aac tcc cac aac gta tac atc atg gcc gac aag cag aag aac ggc
 L   E   Y   N   Y   N   S   H   N   V   Y   I   M   A   D   K   Q   K   N   G
atc aag gtg aac ttc aag atc agg cac aac atc gaa gat gga agc gtg caa ctg gcg gac
 I   K   V   N   F   K   I   R   H   N   I   E   D   G   S   V   Q   L   A   D
cac tac cag cag aac acg ccc atc ggc gat ggc cct gtc ctg ctg ccg gac aac cat tac
 H   Y   Q   Q   N   T   P   I   G   D   G   P   V   L   L   P   D   N   H   Y
ctg tcc acg caa tct gcc ctc tcc aag gac ccc aac gag aag agg gac cac atg gtc ctg
 L   S   T   Q   S   A   L   S   K   D   P   N   E   K   R   D   H   M   V   L
ctg gag ttc gtg acg gct gct ggg atc acg cat ggc atg gat gaa ctc tac aag tga
 L   E   F   V   T   A   A   G   I   T   H   G   M   D   E   L   Y   K   -
```

EC9 co-transforming event: monoallelic

Allele 1: no indels

Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtg<mark>gaactggatggtgatgtgaa</mark><mark style="background:magenta">cgg</mark>gcacaagttctccgtcagcggaga
gggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccactt
tcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaagaa
aggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaagg
tatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaaga
acggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcgat
ggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgga
gttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga

```
atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gat gtg aac ggg cac aag ttc tcc gtc agc gga gag ggt gaa ggt gat gcc acc tac gga
 D   V   N   G   H   K   F   S   V   S   G   E   G   E   G   D   A   T   Y   G
aag ctc acc ctg aag ttc atc tgc act acc gga aag ctc cct gtt ccg tgg cca acc ctc
 K   L   T   L   K   F   I   C   T   T   G   K   L   P   V   P   W   P   T   L
gtc acc act ttc acc tac ggt gtt cag tgc ttc tcc cgg tac cca gat cac atg aag cag
 V   T   T   F   T   Y   G   V   Q   C   F   S   R   Y   P   D   H   M   K   Q
cat gac ttc ttc aag agc gcc atg ccc gaa ggc tac gtg caa gaa agg act atc ttc ttc
 H   D   F   F   K   S   A   M   P   E   G   Y   V   Q   E   R   T   I   F   F
```

```
      H    D    F    F    K    S    A    M    P    E    G    Y    V    Q    E    R    T    I    F    F
     aag  gat  gac  ggg  aac  tac  aag  aca  cgt  gcc  gaa  gtc  aag  ttc  gaa  ggt  gat  acc  ctg  gtg
      K    D    D    G    N    Y    K    T    R    A    E    V    K    F    E    G    D    T    L    V
     aac  cgc  atc  gag  ctg  aaa  ggt  atc  gat  ttc  aag  gaa  gat  gga  aac  atc  ctc  gga  cac  aag
      N    R    I    E    L    K    G    I    D    F    K    E    D    G    N    I    L    G    H    K
     ctg  gag  tac  aac  tac  aac  tcc  cac  aac  gta  tac  atc  atg  gcc  gac  aag  cag  aag  aac  ggc
      L    E    Y    N    Y    N    S    H    N    V    Y    I    M    A    D    K    Q    K    N    G
     atc  aag  gtg  aac  ttc  aag  atc  agg  cac  aac  atc  gaa  gat  gga  agc  gtg  caa  ctg  gcg  gac
      I    K    V    N    F    K    I    R    H    N    I    E    D    G    S    V    Q    L    A    D
     cac  tac  cag  cag  aac  acg  ccc  atc  ggc  gat  ggc  cct  gtc  ctg  ctg  ccg  gac  aac  cat  tac
      H    Y    Q    Q    N    T    P    I    G    D    G    P    V    L    L    P    D    N    H    Y
     ctg  tcc  acg  caa  tct  gcc  ctc  tcc  aag  gac  ccc  aac  gag  aag  agg  gac  cac  atg  gtc  ctg
      L    S    T    Q    S    A    L    S    K    D    P    N    E    K    R    D    H    M    V    L
     ctg  gag  ttc  gtg  acg  gct  gct  ggg  atc  acg  cat  ggc  atg  gat  gaa  ctc  tac  aag  tga
      L    E    F    V    T    A    A    G    I    T    H    G    M    D    E    L    Y    K    -
```

Allele 2: deletion of TG

Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtg<mark>gaactggatggtgatg**TG**aa</mark><mark style="background:magenta">cgg</mark>gcacaagttctccgtcagcggag
agggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccact
ttcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaaga
aaggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaag
gtatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaag
aacggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcga
tggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgg
agttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga

```
     atg  ggc  aag  ggc  gag  gaa  ctg  ttc  act  ggc  gtg  gtc  cca  atc  ctg  gtg  gaa  ctg  gat  ggt
      M    G    K    G    E    E    L    F    T    G    V    V    P    I    L    V    E    L    D    G
     gat  gaa  cgg  gca  caa  gtt  ctc  cgt  cag  cgg  aga  ggg  tga  agg  tga  tgc  cac  cta  cgg  aaa
      D    E    R    A    Q    V    L    R    Q    R    R    G    -    R    -    C    H    L    R    K
     gct  cac  cct  gaa  gtt  cat  ctg  cac  tac  cgg  aaa  gct  ccc  tgt  tcc  gtg  gcc  aac  cct  cgt
      A    H    P    E    V    H    L    H    Y    R    K    A    P    C    S    V    A    N    P    R
     cac  cac  ttt  cac  cta  cgg  tgt  tca  gtg  ctt  ctc  ccg  gta  ccc  aga  tca  cat  gaa  gca  gca
      H    H    F    H    L    R    C    S    V    L    L    P    V    P    R    S    H    E    A    A
     tga  ctt  ctt  caa  gag  cgc  cat  gcc  cga  agg  cta  cgt  gca  aga  aag  gac  tat  ctt  ctt  caa
      -    L    L    Q    E    R    H    A    R    R    L    R    A    R    K    D    Y    L    L    Q
     gga  tga  cgg  gaa  cta  caa  gac  acg  tgc  cga  agt  caa  gtt  cga  agg  tga  tac  cct  ggt  gaa
      G    -    R    E    L    Q    D    T    C    R    S    Q    V    R    R    -    Y    P    G    E
     ccg  cat  cga  gct  gaa  agg  tat  cga  ttt  caa  gga  aga  tgg  aaa  cat  cct  cgg  aca  caa  gct
      P    H    R    A    E    R    Y    R    F    Q    G    R    W    K    H    P    R    T    Q    A
     gga  gta  caa  cta  caa  ctc  cca  caa  cgt  ata  cat  cat  ggc  cga  caa  gca  gaa  gaa  cgg  cat
      G    V    Q    L    Q    L    P    Q    R    I    H    H    G    R    Q    A    E    E    R    H
     caa  ggt  gaa  ctt  caa  gat  cag  gca  caa  cat  cga  aga  tgg  aag  cgt  gca  act  ggc  gga  cca
      Q    G    E    L    Q    D    Q    A    Q    H    R    R    W    K    R    A    T    G    G    P
     cta  cca  gca  gaa  cac  gcc  cat  cgg  cga  tgg  ccc  tgt  cct  gct  gcc  gga  caa  cca  tta  cct
      L    P    A    E    H    A    H    R    R    W    P    C    P    A    A    G    Q    P    L    P
     gtc  cac  gca  atc  tgc  cct  ctc  caa  gga  ccc  caa  cga  gaa  gag  gga  cca  cat  ggt  cct  gct
      V    H    A    I    C    P    L    Q    G    P    Q    R    E    E    G    P    H    G    P    A
     gga  gtt  cgt  gac  ggc  tgc  tgg  gat  cac  gca  tgg  cat  gga  tga  act  cta  caa  gtg
      G    V    R    D    G    C    W    D    H    A    W    H    G    -    T    L    Q    V
```

EC10 co-transforming event: biallelic

Allele 1: deletions of TG

Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtg<mark>gaactggatggtgatg**TG**aa</mark><mark style="background:magenta">cgg</mark>gcacaagttctccgtcagcggag
agggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccact
ttcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaaga
aaggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaag
gtatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaag
aacggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcga
tggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgg
agttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga

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     atg  ggc  aag  ggc  gag  gaa  ctg  ttc  act  ggc  gtg  gtc  cca  atc  ctg  gtg  gaa  ctg  gat  ggt
      M    G    K    G    E    E    L    F    T    G    V    V    P    I    L    V    E    L    D    G
     gat  gaa  cgg  gca  caa  gtt  ctc  cgt  cag  cgg  aga  ggg  tga  agg  tga  tgc  cac  cta  cgg  aaa
      D    E    R    A    Q    V    L    R    Q    R    R    G    -    R    -    C    H    L    R    K
     gct  cac  cct  gaa  gtt  cat  ctg  cac  tac  cgg  aaa  gct  ccc  tgt  tcc  gtg  gcc  aac  cct  cgt
      A    H    P    E    V    H    L    H    Y    R    K    A    P    C    S    V    A    N    P    R
     cac  cac  ttt  cac  cta  cgg  tgt  tca  gtg  ctt  ctc  ccg  gta  ccc  aga  tca  cat  gaa  gca  gca
      H    H    F    H    L    R    C    S    V    L    L    P    V    P    R    S    H    E    A    A
     tga  ctt  ctt  caa  gag  cgc  cat  gcc  cga  agg  cta  cgt  gca  aga  aag  gac  tat  ctt  ctt  caa
      -    L    L    Q    E    R    H    A    R    R    L    R    A    R    K    D    Y    L    L    Q
     gga  tga  cgg  gaa  cta  caa  gac  acg  tgc  cga  agt  caa  gtt  cga  agg  tga  tac  cct  ggt  gaa
      G    -    R    E    L    Q    D    T    C    R    S    Q    V    R    R    -    Y    P    G    E
     ccg  cat  cga  gct  gaa  agg  tat  cga  ttt  caa  gga  aga  tgg  aaa  cat  cct  cgg  aca  caa  gct
      P    H    R    A    E    R    Y    R    F    Q    G    R    W    K    H    P    R    T    Q    A
     gga  gta  caa  cta  caa  ctc  cca  caa  cgt  ata  cat  cat  ggc  cga  caa  gca  gaa  gaa  cgg  cat
      G    V    Q    L    Q    L    P    Q    R    I    H    H    G    R    Q    A    E    E    R    H
```

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caa ggt gaa ctt caa gat cag gca caa cat cga aga tgg aag cgt gca act ggc gga cca
 Q   G   E   L   Q   D   Q   A   Q   H   R   R   W   K   R   A   T   G   G   P
cta cca gca gaa cac gcc cat cgg cga tgg ccc tgt cct gct gcc gga caa cca tta cct
 L   P   A   E   H   A   H   R   R   W   P   C   P   A   A   G   Q   P   L   P
gtc cac gca atc tgc cct ctc caa gga ccc caa cga gaa gag gga cca cat ggt cct gct
 V   H   A   I   C   P   L   Q   G   P   Q   R   E   E   G   P   H   G   P   A
gga gtt cgt gac ggc tgc tgg gat cac gca tgg cat gga tga act cta caa gtg
 G   V   R   D   G   C   W   D   H   A   W   H   G   -   T   L   Q   V
```

Allele 2: deletion of T

Atgggcaagggcgaggaactgttcactggcgtggtcccaatcctggtg<mark>gaactggatggtgatg**T**gaa</mark><mark>cggg</mark>cacaagttctccgtcagcggaga
gggtgaaggtgatgccacctacggaaagctcaccctgaagttcatctgcactaccggaaagctccctgttccgtggccaaccctcgtcaccactt
tcacctacggtgttcagtgcttctcccggtacccagatcacatgaagcagcatgacttcttcaagagcgccatgcccgaaggctacgtgcaagaa
aggactatcttcttcaaggatgacgggaactacaagacacgtgccgaagtcaagttcgaaggtgataccctggtgaaccgcatcgagctgaaagg
tatcgatttcaaggaagatggaaacatcctcggacacaagctggagtacaactacaactcccacaacgtatacatcatggccgacaagcagaaga
acggcatcaaggtgaacttcaagatcaggcacaacatcgaagatggaagcgtgcaactggcggaccactaccagcagaacacgcccatcggcgat
ggccctgtcctgctgccggacaaccattacctgtccacgcaatctgccctctccaaggaccccaacgagaagagggaccacatggtcctgctgga
gttcgtgacggctgctgggatcacgcatggcatggatgaactctacaagtga

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atg ggc aag ggc gag gaa ctg ttc act ggc gtg gtc cca atc ctg gtg gaa ctg gat ggt
 M   G   K   G   E   E   L   F   T   G   V   V   P   I   L   V   E   L   D   G
gat gga acg ggc aca agt tct ccg tca gcg gag agg gtg aag gtg atg cca cct acg gaa
 D   G   T   G   T   S   S   P   S   A   E   R   V   K   V   M   P   P   T   E
agc tca ccc tga agt tca tct gca cta ccg gaa agc tcc ctg ttc cgt ggc caa ccc tcg
 S   S   P   -   S   S   S   A   L   P   E   S   S   L   F   R   G   Q   P   S
tca cca ctt tca cct acg gtg ttc agt gct tct ccc ggt acc cag atc aca tga agc agc
 S   P   L   S   P   T   V   F   S   A   S   P   G   T   Q   I   T   -   S   S
atg act tct tca aga gcg cca tgc ccg aag gct acg tgc aag aaa gga cta tct tct tca
 M   T   S   S   R   A   P   C   P   K   A   T   C   K   K   G   L   S   S   S
agg atg acg gga act aca aga cac gtg ccg aag tca agt tcg aag gtg ata ccc tgg tga
 R   M   T   G   T   T   R   H   V   P   K   S   S   S   K   V   I   P   W   -
acc gca tcg agc tga aag gta tcg att tca agg aag atg gaa aca tcc tcg gac aca agc
 T   A   S   S   -   K   V   S   I   S   R   K   M   E   T   S   S   D   T   S
tgg agt aca act aca act ccc aca acg tat aca tca tgg ccg aca agc aga aga acg gca
 W   S   T   T   T   T   P   T   T   Y   T   S   W   P   T   S   R   R   T   A
tca agg tga act tca aga tca ggc aca aca tcg aag atg gaa gcg tgc aac tgg cgg acc
 S   R   -   T   S   R   S   G   T   T   S   K   M   E   A   C   N   W   R   T
act acc agc aga aca cgc cca tcg gcg atg gcc ctg tcc tgc tgc cgg aca acc att acc
 T   T   S   R   T   R   P   S   A   M   A   L   S   C   C   R   T   T   I   T
tgt cca cgc aat ctg ccc tct cca agg acc cca acg aga aga ggg acc aca tgg tcc tgc
 C   P   R   N   L   P   S   P   R   T   P   T   R   R   G   T   T   W   S   C
tgg agt tcg tga cgg ctg ctg gga tca cgc atg gca tgg atg aac tct aca agt
 W   S   S   -   R   L   L   G   S   R   M   A   W   M   N   S   T   S
```