

The Mouse (*Mus musculus*) T Cell Receptor Delta Variable (TRDV), Diversity (TRDD) and Joining (TRDJ) Genes

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Key Words

IMGT · T cell receptor · Delta variable regions · Delta diversity regions · Delta joining regions

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Abstract

'The Mouse (*Mus musculus*) T Cell Receptor Delta Variable (TRDV), Diversity (TRDD) and Joining (TRDJ) Genes', the 15th report of the 'IMGT Locus in Focus' section, comprises 7 tables entitled: (1) 'Number of mouse (*Mus musculus*) germline TRDV genes at 14D1–D2 and potential repertoire'; (2) 'Mouse (*Mus musculus*) germline TRDV genes at 14D1–D2'; (3) 'Mouse (*Mus musculus*) TRDV allele table'; (4) 'Mouse (*Mus musculus*) germline TRDD genes and alleles'; (5) 'Mouse (*Mus musculus*) germline TRDJ genes'; (6) 'Mouse (*Mus musculus*) TRDJ allele table', and (7) 'Correspondence between the different mouse (*Mus musculus*) TRDV gene nomenclatures'. These tables are available at the IMGT Marie-Paule page from **IMGT**, the international ImmunoGeneTics database (<http://imgt.cines.fr:8104>) created by Marie-Paule Lefranc, Uni-

Introduction

'The Mouse (*Mus musculus*) T Cell Receptor Delta Variable (TRDV), Diversity (TRDD) and Joining (TRDJ) Genes' is the 15th report of the 'IMGT Locus in Focus' section launched in the April 1998 issue of *Experimental and Clinical Immunogenetics* [1–14]. This report on the mouse (*Mus musculus*) T cell receptor delta variable, diversity and joining genes describes the murine germline TRD repertoire, with the same standardized rules of the IMGT Scientific chart [15] which were used for the description of the human germline T cell receptor gene repertoires [8–11, 14]. This report comprises 7 tables entitled: (1) 'Number of mouse (*Mus musculus*) germline TRDV genes at 14D1–D2 and potential repertoire'; (2) 'Mouse (*Mus musculus*) germline TRDV genes at 14D1–D2'; (3) 'Mouse (*Mus musculus*) TRDV allele table';

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(4) 'Mouse (*Mus musculus*) germline TRDD genes and alleles'; (5) 'Mouse (*Mus musculus*) germline TRDJ genes'; (6) 'Mouse (*Mus musculus*) TRDJ allele table', and (7) 'Correspondence between the different mouse (*Mus musculus*) TRDV gene nomenclatures'. These ta-

bles are available at the IMGT Marie-Paule page from **IMGT**, the international ImMunoGeneTics database (<http://imgt.cines.fr:8104>) created by Marie-Paule Lefranc, Université Montpellier II, CNRS, Montpellier, France [15, 16].

Table 1. Number of mouse (*Mus musculus*) germline TRDV genes at 14D1-D2 and potential repertoire

20 TRDV (included 4 TRAV/DV) genes belonging to 11 subgroups:

8 TRDV genes are unique members of a TRDV subgroup (TRDV1 to TRDV5, TRDV7 to TRDV9).

12 genes belongs to 3 TRAV/DV subgroups: eight of them, belonging to the TRAV7/DV6 subgroup, have only been found rearranged to TRDD segments; four of them, designated as TRAV/DV genes and belonging to TRAV7/DV6, TRAV11/DV10 and TRAV17/DV11 subgroups, have been found rearranged either to D and J segments of the TRD locus or to TRAJ segments, and can therefore be used in the synthesis of delta or alpha chains.

Potential repertoire : 20 FUNCTIONAL TRDV genes (included 4 TRAV/DV genes) belonging to 11 subgroups.

TRDV or TRAV/DV subgroup	TRDV or TRAV/DV gene name	Functional	ORF	Pseudogene	Total
1	TRDV1	1	-	-	1
2	TRDV2	1	-	-	1
3	TRDV3	1	-	-	1
4	TRDV4	1	-	-	1
5	TRDV5	1	-	-	1
TRAV7/DV6 (1)	TRDV6S1	1	-	-	1
	TRDV6S2	1	-	-	1
	TRDV6S3	1	-	-	1
	TRDV6S4	1	-	-	1
	TRDV6S5	1	-	-	1
	TRDV6S6	1	-	-	1
	TRDV6S7	1	-	-	1
	TRDV6S8	1	-	-	1
	TRAV7S1/DV6S9	1	-	-	1
	TRAV7S2/DV6S10	1	-	-	1
7	TRDV7	1	-	-	1
8	TRDV8	1	-	-	1
9	TRDV9	1	-	-	1
TRAV11/DV10 (2)	TRAV11S5/DV10	1	-	-	1
TRAV17/DV11 (3)	TRAV17S2/DV11	1	-	-	1
Total		20	0	0	20

IMGT notes:

- (1) The TRAV7/DV6 subgroup comprises ten genes, eight genes (TRDV6S1 to TRDV6S8) have so far only been found rearranged to TRDD segments, whereas two genes (TRDV7S1/DV6S9 and TRAV7S2/DV6S10) have been found rearranged either to D and J segments of the TRD locus or to TRAJ segments.
- (2) The TRAV11/DV10 subgroup comprises seven genes, only the TRAV11S5/DV10 gene has so far been found rearranged to TRDD segments.
- (3) The TRAV17/DV11 subgroup comprises three genes, only the TRAV17S2/DV11 gene has so far been found rearranged to TRDD segments.

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Table 2. Mouse (*Mus musculus*) germline TRDV genes at 14D1-D2

Fct: FUNCTIONALITY

F: Functional

P: Pseudogene

ORF: Open Reading Frame

vg: Vestigial

R: Rearranged

T: Transcribed

Pr: Translated into protein

+ or "-" indicates if the gene sequences have been found (+) or not been found (-) rearranged (R), transcribed (T), and/or translated into protein (Pr). Arbitrarily that information is shown on the first line of each gene when the data have been confirmed by several studies.

Functionality is shown between:

- **parentheses** when the accession number refers to rearranged genomic DNA or cDNA and the corresponding germline gene has not yet been isolated.

- **brackets** when the accession number refers to genomic DNA, but not known as being germline or rearranged.

Reference sequences in bold have been mapped: "mapped" refers to sequences which have been obtained from clones (phages, cosmids, YACs...) either by subcloning or PCR, and does not apply to sequences obtained directly from genomic DNA. In the "Sequences from the literature" column, names of the sequences are preceded by the designation of the mouse strain.

The four V-GENES, TRAV7S1/DV6S9, TRAV7S2/DV6S10, TRAV11S5/DV10 and TRAV17S2/DV11, which have been found rearranged to (D)J segments of the TRD locus or to TRAJ segments, will be reported in the TRAV Germline gene table.

TRDV subgroup	TRDV gene name	Fct	R	T	Pr	Strain	Reference sequences	Accession numbers	Sequences from literature
1	TRDV1	(F)	+	+		BALB/c	VDelta	X63934 [2]#c	
	TRDV2	F	+	+	+	BALB/c	VDelta 2	M94080 [12]	
	TRDV3	F	+	+	+	BALB/c	VDelta 3	M94080 [12]	
		(F)	+	+		BALB/c x 129 (F1)	VDelta	M37280 [3]#c	
4	TRDV4	(F)				B10.A (1)	VDelta 4.2	U28810 [13] ^o	
		F				BALB/c	VDelta 5	M23382 [4]	
		F	+	+	+	B10.D2-H2 ^{dmf} (2)	VDelta 7.3	M23095 [9]	B10.D2-H2 ^{dmf} , VDelta 7.3 [M23098][9](3)
		F	+	+	+	BALB/c	VDelta 5	M64239 [11](4)	
6	TRDV5	(F)	+	+		BALB/c x 129 (F1)	VDelta 5	M37281 [3]#c	
		(F)	+	+		B10.A		AJ271435 [1]#c	
	TRDV6S1	(F)	+	+		C57BL/6	VDelta 6	AF085009 [15](5)#c	
	TRDV6S2	(F)	+	+	+	BALB/c x 129 (F1)	VDelta 6	M37287 [3](6)#g	
	TRDV6S3	(F)	+	+	+	BALB/c x 129 (F1)	VDelta 6	M37285 [3]#c	
		(F)	+	+	+	BALB/c	VDelta 1	M37600 [6]#g	
		(F)	+	+		BALB/c	VDelta 1	X07878 [6]#g	
		(F)	+	+		DBA/2	VDelta 6.6	U66668 [14](5)#c	
		(F)	+	+		DBA/2	VDelta 6.4	U66666 [14](5)#c	
	TRDV6S4	(F)	+	+		AKR		M37694 7#c	

Table 2 (continued)

	TRDV6S5	(F)	+	+		DBA/2	VDelta 6	AF085006 [15](5)#c
	TRDV6S6	(F)	+	+		DBA/2	VDelta 6	AF085008 [15](5)#c
	TRDV6S7	(F)	+	+		C57BL/6	VDelta 6	AF085010 [15](5)#c
	TRDV6S8	(F)	+	+		DBA/2	VDelta 6.5	U66667 [14](5)#c
7	TRDV7	(F)	+	+		C57BL/6	VDelta 7	M26299 [10]#c
8	TRDV8	(F)	+	+		C57BL/10 (8)	VDelta 8	U07557 [8](9)#c
9	TRDV9	(F)	+	+		C57BL/6	VDelta 2.3	X13316 [5](9)#c

#c: rearranged cDNA, #g: rearranged genomic DNA

° DNA genomic sequence, but not known as being germline or rearranged.

IMGT notes

- (1) B10.A is a congenic strain (see MGD, <http://www.informatics.jax.org>, for Strain Nomenclature Guidelines), B10 is the abbreviated symbol of C57BL/10 and A the abbreviated symbol of A/J.
- (2) B10.D2-H2^{dm1} is a congenic strain (see MGD for Strain Nomenclature Guidelines), B10 is the abbreviated symbol of C57BL/10 and D2 the abbreviated symbol of DBA/2J.
- (3) V-GENE is partial (no L-PART1, no L-PART2), and V-REGION is partial: AA 1 to 71 are missing (no FR1-IMGT, no CDR1-IMGT, no FR2-IMGT, no CDR2-IMGT, partial FR3-IMGT).
- (4) The TRDV5 gene is localized in 3' from the TRDC gene and is in an inverted orientation of transcription.
- (5) V-GENE is partial (no L-PART1, no L-PART2), and V-REGION is partial: AA 1 is absent (FR1-IMGT is partial).
- (6) V-GENE is partial: no L-PART1.
- (7) V-GENE is partial (no L-PART1, no L-PART2), and V-REGION is partial: AA 1 to 68 are absent (no FR1-IMGT, no CDR1-IMGT, no FR2-IMGT, no CDR2-IMGT, partial FR3-IMGT).
- (8) This sequence was isolated both from C57BL/10 and C57BL/6 strain mice.
- (9) V-GENE is partial (no L-PART1, no L-PART2), and V-REGION is partial: AA 1 to 9 are absent (FR1-IMGT is partial).

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Table 3. Mouse (*Mus musculus*) TRDV allele table

Fct: FUNCTIONALITY
F: Functional

Functionality is shown between:

- **parentheses** when the accession number refers to rearranged genomic DNA or cDNA and the corresponding germline gene has not yet been isolated.
- **brackets** when the accession number refers to genomic DNA, but not known as being germline or rearranged.

The IMGT allele table refers to the V-REGION polymorphism. It does not include polymorphisms in the other parts of the V-GENE. V-REGION alleles are only described for genes which have at least one Functional or ORF allele. The accession number of a reference sequence is given for each allele.

Nucleotide mutations and amino acid changes in CDR3-IMGT of rearranged sequences are not taken into account for the description of polymorphism.

V-REGION alleles from the four V-GENES, TRAV7S1/DV6S9, TRAV7S2/DV6S10, TRAV11S5/DV10 and TRAV17S2/DV11, which have been found rearranged to (D)J segments of the TRD locus or to TRAJ segments, will be reported in the TRAV Table of alleles and Alignments of alleles.

TRDV subgroup	TRDV gene name	Fct	TRDV allele name	Strain	Accession number	Confirmed by genetics and/or data	Description of mutations
1	1	(F)	V1*01	BALB/c	X63934	+	
2	2	F	V2*01	BALB/c	M94080	+	
3	3	F	V3*01	BALB/c	M94080	+	
4	4	(F)	V4*01	BALB/c x 129 (F1)	M37280	+	a51 a54
		(F)	V4*02	B10.A	U28810		a51>g a54>g
5	5	F	V5*01	BALB/c	M23382		t56 ,V19 c66 c318
		F	V5*02	B10.D2-H2 ^{ent}	M23095	+	c318>g
		F	V5*03	BALB/c	M64239	+	c66>t c318>g
		(F)	V5*04	BALB/c x 129 (F1)	M37281		t56>c,V19>a c66>t
6	6S1	(F)	V6S1*01	B10.A	AJ271435		c32 ,g13 ,A11
		(F)	V6S1*02	C57BL/6	AF085009		c32>g,g33>c,A11>g
	6S2	(F)	V6S2*01	BALB/c x 129 (F1)	M37287	+	
	6S3	(F)	V6S3*01	BALB/c x 129 (F1)	M37285	+	
	6S4	(F)	V6S4*01	BALB/c	M37600	+	c4 ,Q2 ,g31 ,A11 t170 ,g171 ,M57 a206 ,K69 t251 ,L84 g277 ,A93 c291
		(F)	V6S4*02	BALB/c	X07878		g31>c,A11>p
		(F)	V6S4*03	DBA/2	U66668		t170>c, ,M57>T
		(F)	V6S4*04	DBA/2	U66666 (1)		c4>g,Q2>E t170>c,g171>a,M57>T
		(F)	V6S4*05	AKR	M37694 (2)	+	a206>t,K69>I t251>g,L84>R g277>a,A93>T
	6S5	(F)	V6S5*01	DBA/2	AF085006		
	6S6	(F)	V6S6*01	DBA/2	AF085008		
	6S7	(F)	V6S7*01	C57BL/6	AF085010		
	6S8	(F)	V6S8*01	DBA/2	U66667		
7	7	(F)	V7*01	C57BL/6	M26299		
8	8	(F)	V8*01	C57BL/10	U07557		
9	9	(F)	V9*01	C57BL/6	X13316		

IMGT notes:

- (1) The c4>g, Q2>E mutation needs to be confirmed by other data.
- (2) The a206>t, K69>I mutation needs to be confirmed by other data.

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Table 4. Mouse (*Mus musculus*) germline TRDD genes and alleles**Fct:** FUNCTIONALITY**F:** Functional

D-REGION alleles are only described at the nucleotide level since D-REGION can be used in the three reading frames. The numbering starts with the first nucleotide downstream the 5'D-HEPTAMER. The accession number of a reference sequence is given for each allele.

Reference sequences in bold have been mapped: "mapped" refers to sequences which have been obtained from clones (phages, cosmids, YACs...) either by subcloning or PCR, and does not apply to sequences obtained directly from genomic DNA. In the "Sequences from the literature" column, names of the sequences are preceded by the designation of the mouse strain.

TRDD name	Fct	TRDD allele name	Strain	Reference sequences	Accession number	Confirmed by genetics and/or data	Sequences from the literature
TRDD1	F	TRDD1*01	BALB/c	Ddelta 1	X64900 [1]	+	BALB/c, [AF019412][3]
TRDD2	F	TRDD2*01	BALB/c	Ddelta 2	X64901 [1]	+	BALB/c, [AF019412][3] BALB/c, Ddelta 2 [S78583][2]

References:

- [1] Chien, Y.H. et al., Nature, 330, 24-31 (1987).
- [2] Shimamura, M. et al., Eur. J. Immunol., 25, 1541-1546 (1995).
- [3] Rowen, L. et al., unpublished (1997).

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Table 5. Mouse (*Mus musculus*) germline TRDJ genes**Fct:** FUNCTIONALITY**F:** Functional**R:** Rearranged**T:** Transcribed**Pr:** Translated into protein

+ or "-" indicates if the gene sequences have been found (+) or not been found (-) rearranged (R), transcribed (T), and/or translated into protein (Pr). Arbitrarily that information is shown on the first line of each gene when the data have been confirmed by several studies.

Reference sequences in bold have been mapped: "mapped" refers to sequences which have been obtained from clones (phages, cosmids, YACs...) either by subcloning or PCR, and does not apply to sequences obtained directly from genomic DNA. In the "Sequences from the literature" column, names of the sequences are preceded by the designation of the mouse strain.

TRDJ name	Fct	R	T	Pr	Strain	Reference sequences	Accession numbers	Sequences from the literature
TRDJ1	F	+	+	+	BALB/c	Jdelta 1	AF019412 [2]	
	F	+	+	+	BALB/c	Jdelta 2	X64903 [1]	B10.D2-H2 ^{dm1} (1), [M64239][4]
TRDJ2	F(2)				Std:ddY	Jdelta2	X17179 [3]	

IMGT notes:

- (1) B10.D2-H2^{dm1} is a congenic strain (see MGD for Strain Nomenclature Guidelines), B10 is the abbreviated symbol of C57BL/10 and D2 the abbreviated symbol of DBA/2J.
- (2) Nucleotide T, at position 24 (according to the IMGT allele mutation numbering) of TRDJ2 in X64903, is deleted in X17179. This DELETION leads to a frameshift downstream of codon 8. However it is not excluded that V-D-J rearrangements allow to reestablish the normal ORF (see alignment of alleles). For these reasons the TRDJ2*02 is considered as functional.

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- [1] Chien, Y.H. et al., Nature, 330, 24-31 (1987).
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Table 6. Mouse (*Mus musculus*) TRDJ allele table**Fct:** FUNCTIONALITY**F:** Functional

IMGT numbering and description of alleles for germline J-REGIONS start with the first nucleotide of the first codon.
The accession number of a reference sequence is given for each allele.

TRDJ name	Fct	TRDJ allele name	Strain	Accession number	Confirmed by genetics and/or data	Description of mutations
TRDJ1	F	TRDJ1*01	BALB/c	AF019412	+	
TRDJ2	F	TRDJ2*01	BALB/c	X64903	+	t24
	F(1)	TRDJ2*02	Std:ddY	X17179		t24>del#

IMGT note:

- (1) Nucleotide T, at position 24 (according to the IMGT allele mutation numbering) of TRDJ2 in X64903, is deleted in X17179. This DELETION leads to a frameshift downstream of codon 8. However it is not excluded that V-D-J rearrangements allow to reestablish the normal ORF (see alignment of alleles). For these reasons the TRDJ2*02 is considered as functional.

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Author: Nathalie Bosc imgt@ligm.igh.cnrs.fr**Table 7.** Correspondence between the different mouse (*Mus musculus*) TRDV gene nomenclatures

TRDV genes are listed from 3' (top of the table) to 5' (bottom of the table).

The four V-GENEs, TRAV7S1/DV6S9, TRAV7S2/DV6S10, TRAV11S5/DV10 and TRAV17S2/DV11, which have been found rearranged to (D)J segments of the TRD locus or to TRAJ segments, are reported in this table.

IMGT TRDV gene name [1]	Arden et al. [2]
TRDV1	DV101S1
TRDV2	DV102S1
TRDV3	DV6S2
TRDV4	DV104S1
TRDV5	DV105S1
TRDV6S1	DV7S3
TRDV6S2	DV7S4
TRDV6S3	DV7S5
TRDV6S4	DV7S6
TRDV6S5	
TRDV6S6	
TRDV6S7	
TRDV6S8	
TRAV7S1/DV6S9	ADV7S1
TRAV7S2/DV6S10	ADV7S2
TRDV7	DV10S7
TRDV8	DV2S8
TRDV9	DV4S8
TRAV11S5/DV10	ADV11S5
TRAV17S2/DV11	ADV17S2

IMGT note:

TRDV genes are designated by a number for the subgroup followed, whenever there are several genes belonging to the same subgroup, by the letter S and a number.

References:

- [1] Bosc N., and Lefranc M.-P., Exp. Clin. Immunogenet. (this paper)
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