

Appendix A Primers used for detection of apple virus

Virus	Primer names	Primer sequences (5'-3')	Positions (nt) ^a	Size (bp)	References
ACLSV	A52	CAGACCCTTATTGAAGTCGAA	7232-7212	358	Cieslinska <i>et al.</i> 1995
	A53	GGCAACCCTGGAACAGA	6875-6891		
	ACF1	TGGAGTCCATCTTCGCGAAC	6913-6922	590	Hu <i>et al.</i> 2015
	ACR1	CTCTTTCATGGGTTCAAGAG	7522-7503		
ASGV	C6396	CTGCAAGACCGCGACCAAGTTT	6393-6396	524	Clover <i>et al.</i> 2003
	H5873	CCCCTGTGTTGGATTGATACACCTC	5872-5896		
	AGF1	ATGAGTTTGGAAAGACGTGC	5640-5658	713	Hu <i>et al.</i> 2015
	AGR1	GACTAACCCCTCCAGTTCC	6338-6353		
ASPV	ASP-C	CTCTTGAACCAGCTGATGGC	8993-9012	264	Jelkmann and Keim-Konrad 1997
	ASP-A	ATAGCCGCCCGGTTAGGTT	9237-9256		
	ASPV-3A	AGCGGTTGCCTATTTTTGCTCC	3480-3501	291	
	ASPV-3B	GTGAGGTCAAAGATGCTGAAACC	3748-3770		
ASSVd	AS1	CCGGCCTTCGTCGACGACGA	82-101	330	Sipahioglu <i>et al.</i> 2006
	AS3	TGAGAAAGGAGCTGCCAGCAC	102-122		
	ASSVd1	CCGGATCCGGTAAACACCGTGC GGTTCCC	1-20	330	Hu <i>et al.</i> 2017
	ASSVd2	CCGGATCCGGGAAACACCTATTGTGTTT	312-330		
PNRSV	PNRSV 1A	GGTTTGCCGAATTTGCAATC	1110-1129	659bp	This study
	PNRSV 1B	TCATCGACCAGCAAGACATC	1750-1769		
	PNRSV 2A	CTTGAAGGACCAACCGAG	1569-1586	348bp	Mekuria <i>et al.</i> 2003
	PNRSV 2B	ATCTGCTAACGCAGGTAAG	1899-1917		
ApMV	PAPMCP3	CTAATCGCTCCATCATAATTC	1766-1786	666	Rana <i>et al.</i> 2011
	PAPMCP5	TCAACATGGTCTGCAAGTAC	1119-1140		
	AM-F1	ATGACAACACTGGGAGATAAACC	170-193	530	This study
	AM-R1	TCGTCCGGCTCATGGTTTCATCCCAGAA	674-700		
ApNMV	ApNMV-CP+1	CTTGCGTGCAATCGATATGG	1120-1139	685	Noda <i>et al.</i> 2017
	ApNMV-CP-1	TCATCTCAACCTAGACATCC	1786-1805		
	ApNMV-CP+2	ATGGTGTGCAATCGCTGTCA	1136-1155	640	Noda <i>et al.</i> 2017
	ApNMV-CP-2	CATCGACCATAAGGATATCA	1756-1775		

^a Positions refer to the nucleotide, relative to virus genomic sequences available in GenBank.

Reference

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3. Hu G J, Dong Y F, Zhang Z P, Fan X D, Ren F, Li Z. 2017. Occurrence and genetic diversity analysis of apple stem pitting virus isolated from apples in China. *Archives of Virology*, **162**, 2397–2402.

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Appendix B Primers used for the amplification of full genome of *Apple necrotic mosaic virus*

(ApNMV)

Fragments	Primer names	Primer sequences (5'-3')	Positions (nt)	Size (bp)
RNA1	F1	AACTTCCGGTTCGAGTTAT	254-273	1044
	R1	ACATCTTCTTCGTCCTAACGTA	1277-1298	
	F2	GAAGACTGGTGGTACGATGTTAC	1037-1059	1438
	R2	TTCTCTCGCAATCCATGGCAGATGATC	2448-2475	
	F3	GTTGTGAATAAGTATGCTTCCGAGA	1877-1901	
	R3	CTATGACAGGGACCCATCAACGG	3053-3075	
RACE	5'-Outer primer	GTTCTGTGATCGGAAGGTCCTCGTAGC	605-632	
	5'-Inner primer	CTTCTGTGTCACACTCTTCGAATCT	557-580	
	3'-Outer primer	AGACAGCCAATAGAGTGATGCGAAGTATG	2811-2839	
	3'-Inner primer	CACACTCAGGCAGACAAGTGC	2900-2920	
RNA2	F4	ACTCGACGATGAGGTTCCAGCTCTACC	664-690	1581
	R4	GTAATCTCTCATCATCGAGAC	2225-2245	
RACE	5'- primer	Outer CAACAACAATCTCCTTMACCAACATCA	768-794	
	5'- primer	Inner GYGTRTGTCTCACAGGCATCTCCAA	905-929	
	3'- primer	Outer AGGCGAAGTTTCTCATAATCAGGCTT	2016-2042	
	3'- primer	Inner GTGTTAGCMGTTCCGAAYGCACTTA	2096-2120	
RNA3	F5	ACCGACAAAGGGTTGTCATGTTCTGCATT	303-331	1263
	R5	AACCCTTCCTGGACAAGGCACTC	1544-1566	
RACE	5'-Outer primer	GGATTCGGCTTCTTGACATAAGTC	714-737	
	5'-Inner primer	ACCACATCGGAGACCTCACC	523-542	
	3'-Outer primer	CGAGTACCGAGAGGATATGTGGCA	1332-1355	
	3'-Inner primer	GTTGCGACTAGTGCTGGGAAGTTC	1374-1397	
	Universal	CTAATACGACTCACTATAGGGCAAGCAGTGGT	Kit	
	Primer A Mix	ATCAACGCAGAG		
	Nested Universal Primer A	AAGCAGTGGTATCAACGCAGAGT		

Appendix C The GenBank accession numbers of *Apple necrotic mosaic virus* isolates used for

phylogenetic analysis

Isolates	Host	Host species	Accession No.			Origins	Ref.
			RNA1	RNA2	RNA3		
Hai	Crabapple	<i>Malus</i> <i>Chaenomeles</i>	MG924894	MG924897	MG924900	Shandong, China	This study
Hua	Apple	<i>M. domestica</i>	MG924895	MG924898	MG924901	Liaoning, China	This study
Qu	Apple	<i>M. domestica</i>	MG924896	MG924899	MG924902	Liaoning, China	This study
P129	Apple	<i>M. domestica</i>	LC108993	LC108994	LC108995	Japan	Noda <i>et al.</i> 2017
Chr3	Cherry	<i>Cerasus</i> <i>pseudocerasus</i> (Lindl.) G. Don	JN416771	JN416772	JN416773	Canada	Cui <i>et al.</i> 2012
MD1-IND	Apple	<i>M. domestica</i>	HE574162	HE574163	HE574164	Indian	Lakshmi <i>et al.</i> 2011

References

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2. Lakshmi V, Hallan V, Ram R, Ahmed N, Zaidi A A, Varma A. 2011. Diversity of *Apple mosaic virus* isolates in India based on coat protein and movement protein genes. *Indian Journal of Virology*, **22**, 44-49.
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Table S4 List of RNA1, RNA2 and RNA3 sequences showing putative recombination events

Isolate s	Parental isolates		Break point ^a		RDP-implemented method (<i>P</i> -value)						
	Major	Minor	St ar t	E nd	R	G	B	M	C	S	3S
RNA1											
ApN	ApNM	ApN	32	33	6.968	3.745	2.545	2.419	1.973	-	2.190
MV-H ai	V-Qu ua	MV-H ua	1	31	$\times 10^{-0}$ 7	$\times 10^{-0}$ 8	$\times 10^{-0}$ 9	$\times 10^{-0}$ 5	$\times 10^{-0}$ 5		$\times 10^{-0}$ 3
RNA2											
ApN	ApNM	ApN	57	27	5.927	9.320	2.783	2.639	2.372	2.370	2.562
MV-H ua	V-Qu ua	MV-H ai	8	60	$\times 10^{-1}$ 5	$\times 10^{-1}$ 7	$\times 10^{-0}$ 5	$\times 10^{-1}$ 2	$\times 10^{-1}$ 2	$\times 10^{-1}$ 4	$\times 10^{-1}$ 2
ApN	ApNM	ApN	21	27	6.077	3.126	1.505	8.563	-	5.465	1.740
MV-Q u	V-Hua	MV-H ai	38	08	$\times 10^{-1}$ 2	$\times 10^{-1}$ 1	$\times 10^{-1}$ 2	$\times 10^{-0}$ 9		$\times 10^{-1}$ 1	$\times 10^{-1}$ 0
ApN	ApNM	ApN	59	27	1.762	-	4.272	5.010	-	6.257	8.033
MV-Q u	V-P12 9	MV-H ai	7	08	$\times 10^{-0}$ 2		$\times 10^{-0}$ 3	$\times 10^{-0}$ 7		$\times 10^{-0}$ 5	$\times 10^{-0}$ 3

The suite of recombination detection programs used for the detection of recombination events and the corresponding average *P*-values were as follows: R: RDP; G: GENECONV; B: Bootscan; M: MaxChi; C: Chi-maera; S: SiScan; 3S: 3Sep.

^aPosition in alignment.