FAO/OIE Reference Laboratory Report
July-September 2006

Foot-and-Mouth Disease

FMD Trends

Summary

No outbreaks were officially reported in FMD-free countries that did not practice vaccination. FMD remained largely confined to traditionally infected areas between July and September 2006.

In July 2006, 22 cases of FMD due to serotype A were reported in cattle in Cayirdere (Istanbul province, Tukey). This followed an outbreak (6 cases in cattle) in Evrese (Canakkale province) in June 2006. These outbreaks are said to have been brought under control. Further to the outbreaks reported earlier in the year (isolates characterised at Pirbright), there have been no recent reports of serotype A outbreaks in Egypt.

In South America, areas of southern Brazil and northern Argentina that were formerly FMD-free with vaccination have continued with measures to regain the free status. In Argentina (Corrientes), the outbreak of serotype O (reported in Feb 2006) has been brought under control using a "stamping out" and vaccination (polyvalent O, A, and C vaccine) campaign. Serosurveillance in Mato Grosso do Sul and Parana still leaves some uncertainty concerning continued low level virus circulation. Elsewhere, outbreaks of serotype O were reported in Ecuador in August 2006. Movement restriction measures on susceptible animals located within a 10-km radius of the outbreak have been applied. To date, there is no suspicion of the presence of sick animals within the affected zone or elsewhere in the country.

Outbreaks of Asia-1 continue to be reported in Asia. The latest reports of cases (128 cattle) were in September 2006 by the Chinese authorities in Tibet. Other cases in cattle had also been reported previously in Qinghai and Gansu provinces in July and August. A variety of measures are being used in an attempt to control these outbreaks such as stamping out, animal movement controls and vaccination.

Cases of FMD caused by SAT3 serotype were reported in Limpopo province, South Africa in August 2006. This outbreak occurred well within the OIE recognised buffer zone (vaccination area) of the FMD control zone of South Africa adjacent to the Kruger National Park. The status of South Africa's FMD free zone without vaccination has not been affected by this outbreak, and therefore South Africa's FMD status has not changed and the export of animals and animal products from South Africa is not affected. It is assumed that contact between infected Kruger National Park African buffalo (*Syncerus caffer*) and cattle took place.

The WRL vaccine recommendations remain unchanged.

Middle East/southern Asia

FMDV serotype O

Nine serotype O viruses collected during 2004-2006 from Israel were sequenced and 5 were shown to be closely related to other PanAsia strains from the region. The remaining 4 isolates were most closely related to Turkish PanAsia viruses received to the WRL during 2005.

FMDV serotype A

Fourteen serotype A viruses collected from Turkey during 2006 were characterized as being related to other viruses causing outbreaks in the region (related to Irn05).

Southeast Asia and the Far East

FMDV serotype O

Serotype O (14 isolates) from Vietnam (collected 2004-2006) were characterized. These were found to represent 3 separate serotype O topotypes (SEA, ME-SA and CATHAY). Interesting, two separate lineages of the CATHAY topotype were represented indicating at least two separate introductions of these viruses into Vietnam (see Annex 2, Figure 2). Incomplete zoo-sanitary measures and shortage of vaccine have led to widespread outbreaks of FMD affecting cattle and pigs.

FMDV serotype Asia 1

Four Asia 1 isolates from Vietnam collected recently in 2006 were characterized. These were found to be closely related to other isolates collected from the region (2005), including viruses analysed by the Thai Regional Reference Laboratory. (See Annex 2, Figure 3)

Africa

FMDV serotype O
Ten isolates from Kenya received at the WRL between 2004 and 2005 were sequenced. These were all characterised as belonging the East Africa-2 topotype on 2 separate lineages. Three further serotype O isolates from Niger (collected during 2005) were closely related to each other within the West-Africa O topotype (see Annex 2, Figure 1).

FMDV serotype A
Three serotype A isolates from Kenya were characterised as belonging to the Africa topotype. Isolates KEN 12/2005 and KEN 3/2006 were closely related

FMDV serotype SAT 2
SAT 1 FMDV was isolated in 7 samples collected from Botswana in 2006. These isolates were found to be very closely related to each other within the WZ topotype (see Annex 2, figure 4).

Vaccine matching

FMDV isolates of serotype A (Iran, Cameroon, Ethiopia, Kenya and Togo) and Serotype O (Israel and Malaysia) collected between 2001 and 2006 were further characterized by VNT (Annex 1; TABLE C).

As a consequence of the new recommendation on vaccine strains (provided by the FMD FAO World Reference Laboratory to the Executive Committee of the European Commission for the Control of FMD see Annex 4) reported in the last report, further testing of Serotype A viruses (in addition to results described in the last report) has been performed. Six Iranian viruses have been tested for match against a selection of serotype A vaccines strains. The closest match was obtained with A22 Iraq, whilst a poor match was found with A22/550 Azerbaijan vaccine. Additional African serotype A viruses (from Cameroon, Ethiopia, Kenya and Togo) were also tested for cross-reaction with the A Eritrea vaccine strain. All showed a rather poor match with this vaccine strain.

Four serotype O viruses collected from 2 countries (Israel and Malaysia) were tested against O Manisa. All showed good cross-reaction to O manias apart from O ISR 1/05.

Publication of data to the scientific community

FMD papers published in the reporting period from the Pirbright Laboratory (Pirbright authors underlined):

1: Cottam EM, Haydon DT, Paton DJ, Gloster J, Wilesmith JW, Ferris NP, Hutchings GH, King DP.
Molecular epidemiology of the foot-and-mouth disease virus outbreak in theUnited Kingdom in 2001.
J Virol. 2006 Sep 13; [Epub ahead of print]

2 Ferris NP, King DP, Reid SM, Shaw AE, Hutchings GH.
Comparisons of original laboratory results and retrospective analysis by real-time reverse transcriptase-PCR of virological samples collected from confirmed cases of foot-and-mouth disease in the UK in 2001.
Vet Rec. 2006 Sep 16;159(12):373-8.

3: Nayak A, Goodfellow IG, Woolaway KE, Birtley J, Curry S, Belsham GJ.
Role of RNA structure and RNA binding activity of foot-and-mouth disease virus 3C protein in VPg uridylylation and virus replication.
J Virol. 2006 Oct;80(19):9865-75.

4: Burman A, Clark S, Abrescia NG, Fry EE, Stuart DI, Jackson T.
Specificity of the VP1 GH loop of Foot-and-Mouth Disease virus for alphav integrins.
J Virol. 2006 Oct;80(19):9798-810.

5: Gerner W, Denyer MS, Takamatsu HH, Wileman TE, Wiesmuller KH, Pfaff E, Saalmuller A.
Identification of novel foot-and-mouth disease virus specific T-cell epitopes in c/c and d/d haplotype miniature swine.

Virus Res. 2006 Nov;121(2):223-8.

6: Paton DJ, de Clercq K, Greiner M, Dekker A, Brocchi E, Bergmann I, Sammin DJ, Gubbins S, Parida S.
Application of non-structural protein antibody tests in substantiating freedom from foot-and-mouth disease virus infection after emergency vaccination of cattle.
Vaccine. 2006 Jul 5; [Epub ahead of print]

7: Ferris NP, King DP, Reid SM, Hutchings GH, Shaw AE, Paton DJ, Goris N, Haas
B, Hoffmann B, Brocchi E, Bugnetti M, Dekker A, De Clercq K.
Foot-and-mouth disease virus: A first inter-laboratory comparison trial to evaluate virus isolation and RT-PCR detection methods.
Vet Microbiol. 2006 Oct 31;117(2-4):130-40.

8: Bronsvoort BM, Anderson J, Corteyn A, Hamblin P, Kitching RP, Nfon C, Tanya VN, Morgan KL.
Geographical and age-stratified distributions of foot-and-mouth disease virus-seropositive and probang-positive cattle herds in the Adamawa province of Cameroon.
Vet Rec. 2006 Sep 2;159(10):299-308

9: Gloster J, Williams P, Doel C, Esteves I, Coe H, Valarcher JF.
Foot-and-mouth disease - Quantification and size distribution of airborne particles emitted by healthy and infected pigs.
Vet J. 2006 Aug 9; [Epub ahead of print]
PMID: 16904353 [PubMed - as supplied by publisher]

Annex 1.

Table A: Summary of clinical sample diagnostics made by the WRL between July–September 2006

Country	WRL for FMD Sample Identification	Animal	Date of Collection	Results		
				VI/ELISA	RT-PCR	Final report
BENIN	BEN 1/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 2/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 3/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 4/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 5/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 6/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 7/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 8/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 9/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 10/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 11/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 12/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 13/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 14/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 15/2005	Cattle	00.08.05	NVD	Negative	NVD
	BEN 16/2005	Cattle	00.08.05	NVD	Negative	NVD
BOTSWANA	BOT 12/2006	Cattle	09.06.06	SAT 1	Positive	SAT 1
	BOT 13/2006	Cattle	09.06.06	SAT 1	Positive	SAT 1
	BOT 14/2006	Cattle	09.06.06	SAT 1	Positive	SAT 1
	BOT 15/2006	Cattle	09.06.06	SAT 1	Positive	SAT 1
	BOT 16/2006	Cattle	09.06.06	SAT 1	Positive	SAT 1
	BOT 17/2006	Cattle	09.06.06	SAT 1	Positive	SAT 1
	BOT 18/2006	Cattle	09.06.06	SAT 1	Positive	SAT 1
IRELAND	IRL 1/2006	Cattle	08.07.06	NVD	Negative	NVD
	IRL 2/2006	Cattle	08.07.06	NVD	Negative	NVD
	IRL 3/2006	Cattle	08.07.06	NVD	Negative	NVD
	IRL 4/2006	Cattle	08.07.06	NVD	Negative	NVD
	IRL 5/2006	Cattle	07.08.06	NVD	Negative	NVD
	IRL 6/2006	Cattle	07.08.06	NVD	Negative	NVD
LAOS	LAO 1/2006	Cattle	27.03.06	A	Positive	A
	LAO 2/2006	Cattle	23.04.06	O	Positive	O
	LAO 3/2006	Cattle	24.04.06	O	Positive	O
	LAO 4/2006	Cattle	24.04.06	O	Positive	O
	LAO 5/2006	Cattle	09.05.06	O	Positive	O
MYANMAR	MYA 1/2005	NK	03.08.05	Asia 1	Positive	Asia 1
NIGER	NGR 1/2005	Cattle	00.12.05	NVD	Positive	FMDV GD
	NGR 2/2005	Cattle	00.12.05	NVD	Negative	NVD
	NGR 3/2005	Cattle	00.12.05	O	Positive	O
	NGR 4/2005	Cattle	00.12.05	NVD	Negative	NVD
	NGR 5/2005	Cattle	00.12.05	NVD	Negative	NVD
	NGR 6/2005	Cattle	00.12.05	NVD	Negative	NVD
	NGR 7/2005	Cattle	00.12.05	NVD	Negative	NVD

	NGR 8/2005	Cattle	00.12.05	NVD	Negative	NVD
	NGR 9/2005	Cattle	00.12.05	NVD	Positive	FMDV GD
	NGR 10/2005	Cattle	00.12.05	O	Positive	O
	NGR 11/2005	Cattle	00.12.05	NVD	Negative	NVD
	NGR 12/2005	Cattle	00.12.05	NVD	Negative	NVD
	NGR 13/2005	Cattle	00.12.05	NVD	Negative	NVD
	NGR 14/2005	Cattle	00.12.05	O	Positive	O
	NGR 15/2005	Cattle	00.12.05	SAT 2	Positive	SAT 2
	NGR 16/2005	Cattle	00.12.05	NVD	Negative	NVD
PAKISTAN	PAK 17/2006	Buffalo	NK	NVD	Positive	FMDV GD
	PAK 18/2006	Buffalo	NK	A	Positive	A
	PAK 19/2006	Buffalo	NK	NVD	Positive	FMDV GD
	PAK 20/2006	Buffalo	NK	A	Positive	A
	PAK 21/2006	Cattle	NK	A	Positive	A
	PAK 22/2006	Cattle	NK	A	Positive	A
	PAK 23/2006	Cattle	NK	A	Positive	A
	PAK 24/2006	Cattle	NK	NVD	Positive	FMDV GD
	PAK 25/2006	Cattle	NK	A	Positive	A
	PAK 26/2006	Cattle	NK	NVD	Positive	FMDV GD
	PAK 27/2006	Cattle	NK	NVD	Positive	FMDV GD
	PAK 28/2006	Buffalo	NK	O	Positive	O
	PAK 29/2006	Buffalo	NK	O	Positive	O
	PAK 30/2006	Cattle	NK	NVD	Positive	FMDV GD
	PAK 31/2006	Cattle	NK	NVD	Positive	FMDV GD
	PAK 32/2006	Buffalo	NK	NVD	Positive	FMDV GD
	PAK 33/2006	Buffalo	NK	O	Positive	O
	PAK 34/2006	Buffalo	NK	O	Positive	O
	PAK 35/2006	Buffalo	NK	O	Positive	O
	PAK 36/2006	Buffalo	NK	O	Positive	O
	PAK 37/2006	Cattle	NK	O	Positive	O
	PAK 38/2006	Buffalo	NK	O	Positive	O
	PAK 39/2006	Buffalo	NK	NVD	Positive	FMDV GD
	PAK 40/2006	Buffalo	NK	NVD	Negative	NVD
	PAK 41/2006	Buffalo	NK	NVD	Positive	FMDV GD
	PAK 42/2006	Cattle	NK	NVD	Positive	FMDV GD
	PAK 43/2006	Cattle	NK	O	Positive	O
	PAK 44/2006	Cattle	NK	NVD	Positive	FMDV GD
	PAK 45/2006	Cattle	NK	O	Positive	O
	PAK 46/2006	Buffalo	NK	NVD	Positive	FMDV GD
	PAK 47/2006	Cattle	NK	NVD	Positive	FMDV GD
	PAK 48/2006	Cattle	NK	NVD	Positive	FMDV GD
	PAK 49/2006	Cattle	NK	NVD	Positive	FMDV GD
	PAK 50/2006	Cattle	NK	NVD	Positive	FMDV GD
	PAK 51/2006	Cattle	NK	O	Positive	O
	PAK 52/2006	Buffalo	NK	NVD	Negative	NVD
	PAK 53/2006	Buffalo	NK	NVD	Positive	FMDV GD
THAILAND	TAI 1/2005	Cattle	23.08.05	O	Positive	O
	TAI 2/2005	Cattle	13.09.05	A	Positive	A
	TAI 3/2005	Cattle	13.09.05	A	Positive	A
	TAI 4/2005	Cattle	07.11.05	A	Positive	A
	TAI 5/2005	Pig	26.11.05	O	Positive	O
	TAI 6/2005	Pig	27.11.05	O	Positive	O
	TAI 7/2005	NK	30.11.05	A	Positive	A

	TAI 8/2005	Cattle	05.12.05	O	Positive	O
	TAI 9/2005	Cattle	05.12.05	O	Positive	O
	TAI 10/2005	Cattle	00.00.05	O	Positive	O
	TAI 11/2005	Cattle	00.00.05	A	Positive	A
TURKEY	TUR 4/2006	Cattle	15.05.06	A	Positive	A
	TUR 5/2006	Cattle	16.05.06	NVD	Negative	NVD
	TUR 6/2006	Cattle	17.05.06	A	Positive	A
	TUR 7/2006	Cattle	07.06.06	A	Positive	A
	TUR 8/2006	Cattle	07.06.06	A	Positive	A
	TUR 9/2006	Cattle	08.06.06	A	Positive	A
	TUR 10/2006	Cattle	12.06.06	A	Positive	A
	TUR 11/2006	Cattle	14.06.06	A	Positive	A
	TUR 12/2006	Cattle	14.06.06	A	Positive	A
	TUR 13/2006	Cattle	14.06.06	NVD	Negative	NVD
	TUR 14/2006	Cattle	15.06.06	A	Positive	A
	TUR 15/2006	Cattle	19.06.06	NVD	Positive	FMDV GD
	TUR 16/2006	Cattle	20.06.06	A	Positive	A
	TUR 17/2006	Cattle	22.06.06	A	Positive	A
	TUR 18/2006	Cattle	22.06.06	A	Positive	A
	TUR 19/2006	Cattle	22.06.06	A	Positive	A
	TUR 20/2006	Cattle	23.06.06	A	Positive	A
	TUR 21/2006	Cattle	06.07.06	NVD	Positive	FMDV GD
VIETNAM	VIT 8/2006	Cattle	23.01.06	Asia 1	Positive	Asia 1
	VIT 9/2006	Cattle	23.01.06	Asia 1	Positive	Asia 1
	VIT 10/2006	Buffalo	06.03.06	Asia 1	Positive	Asia 1
	VIT 11/2006	Buffalo	06.03.06	Asia 1	Positive	Asia 1

*
Institute for Animal Health, Pirbright Laboratory, Woking, Surrey GU24 0NF
VI/ELISA
FMD (or SVD) virus serotype identified following virus isolation in cell culture and antigen detection ELISA
FMD
foot-and-mouth disease
SVD
swine vesicular disease
NVD
no FMD, SVD or vesicular stomatitis virus detected
RT-PCR
reverse transcription polymerase chain reaction for FMD (or SVD) viral genome
NPF, 5 October 2006

TABLE B: Summary of samples received to date during 2006

Country	No. of samples	Virus isolation in cell culture/ELISA									RT-PCR for FMD (or SVD) virus (where appropriate)	
		FMD virus serotypes							SVD virus	NVD		
		O	A	C	SAT 1	SAT 2	SAT 3	Asia 1			Positive	Negative
BENIN	16	-	-	-	-	-	-	-	-	16	-	16
BOTSWANA	18				7	3				8	17	1
D.R. CONGO	116	42	-	-	-	-	-	-	-	74	78	38
EGYPT	5	-	5	-	-	-	-	-	-	-	5	-
HONG KONG	15	13	-	-	-	-	-	-	-	2	14	1
IRAN	10	3	2	-	-	-	-	-	-	5	6	4
IRELAND	6	-	-	-	-	-	-	-	-	6	-	6
ISRAEL	7	7	-	-	-	-	-	-	-	-	7	-
KENYA	36	8	1	-	7	5	-	-	-	15	33	3
KUWAIT	3	2	-	-	-	-	-	-	-	1	2	1
LAOS	5	4	1	-	-	-	-	-	-	-	5	-
MYANMAR	1	-	-	-	-	-	-	1	-	-	1	-
NIGER	16	3	-	-	-	1	-	-	-	12	6	10
PAKISTAN	53	21	9	-	-	-	-	-	-	23	50	3
RWANDA	1	-	-	-	-	-	-	-	-	1	-	1
SAUDI ARABIA	2	-	2	-	-	-	-	-	-	-	2	-
SENEGAL	9	1	-	-	-	-	-	-	-	8	-	9
THAILAND	11	6	5	-	-	-	-	-	-	-	11	-
TURKEY	15	5	10	-	-	-	-	-	-	-	15	-
VIETNAM	31	15	10	-	-	-	-	6	-	-	31	-
TOTAL	**376**	**130**	**45**	**-**	**14**	**9**	**-**	**7**	**-**	**171**	**283**	**93**

*	Institute for Animal Health, Pirbright Laboratory, Woking, Surrey GU24 0NF
VI/ELISA	FMD (or SVD) virus serotype identified following virus isolation in cell culture and antigen detection ELISA
FMD	foot-and-mouth disease
SVD	swine vesicular disease
NVD	no FMD, SVD or vesicular stomatitis virus detected
RT-PCR	reverse transcription polymerase chain reaction for FMD (or SVD) viral genome

NPF, Sep 2006

TABLE C: Antigenic characterisation of FMD field isolates by matching with vaccine strains. r Values were obtained by VNT

R value

Strain	A22	A22/550 ARRIAH	A 5925	A Irn96	A Eritrea 98	O Manisa
A Irn 04/05	>1.00	0.17	0.43	0.11		
A Irn 05/05	0.71	0.15	0.51	0.11		
A Irn 05/06	0.48	0.15		0.09		
A Irn 07/06	0.38	0.14		0.09		
A Car 36/05					0.25	
A Eth 16/05					0.22	
A Ken 12/05					0.24	
A Tog 9/05					0.22	
O Isr 1/05						0.07
O Isr 11/04						>1.0
O May 4/05						>1.0
O May 6/05						>1.0

Interpretation of r_1 values

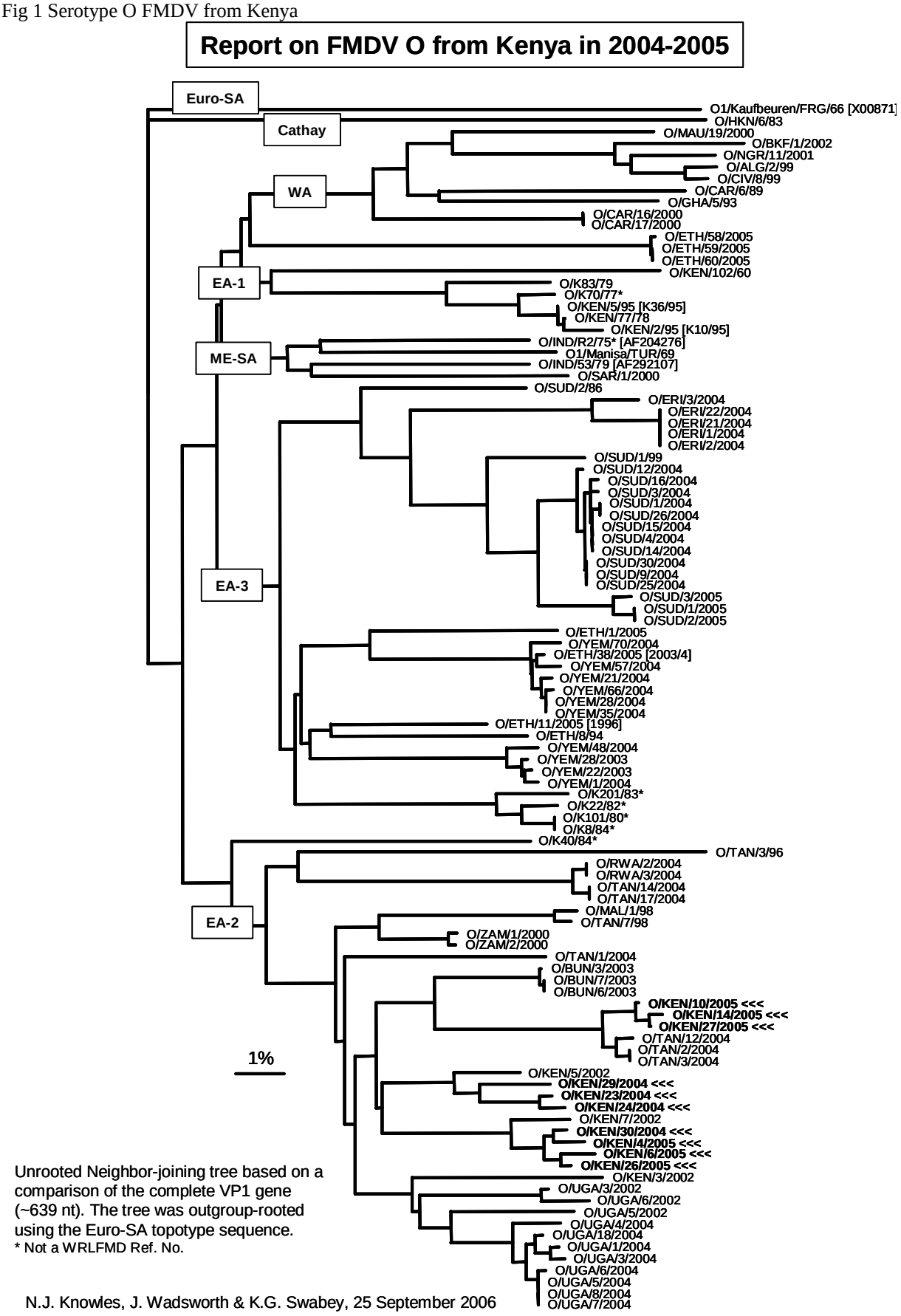
In the case of VNT:

$r_1 = \geq 0.3$. Suggests that there is a close relationship between field isolate and vaccine strain. A potent vaccine containing the vaccine strain is likely to confer protection.

$r_1 = < 0.3$. Suggests that the field isolate is so different from the vaccine strain that the vaccine is unlikely to protect.

Annex 2: Phylogenetic analysis of characterised FMDV isolates:

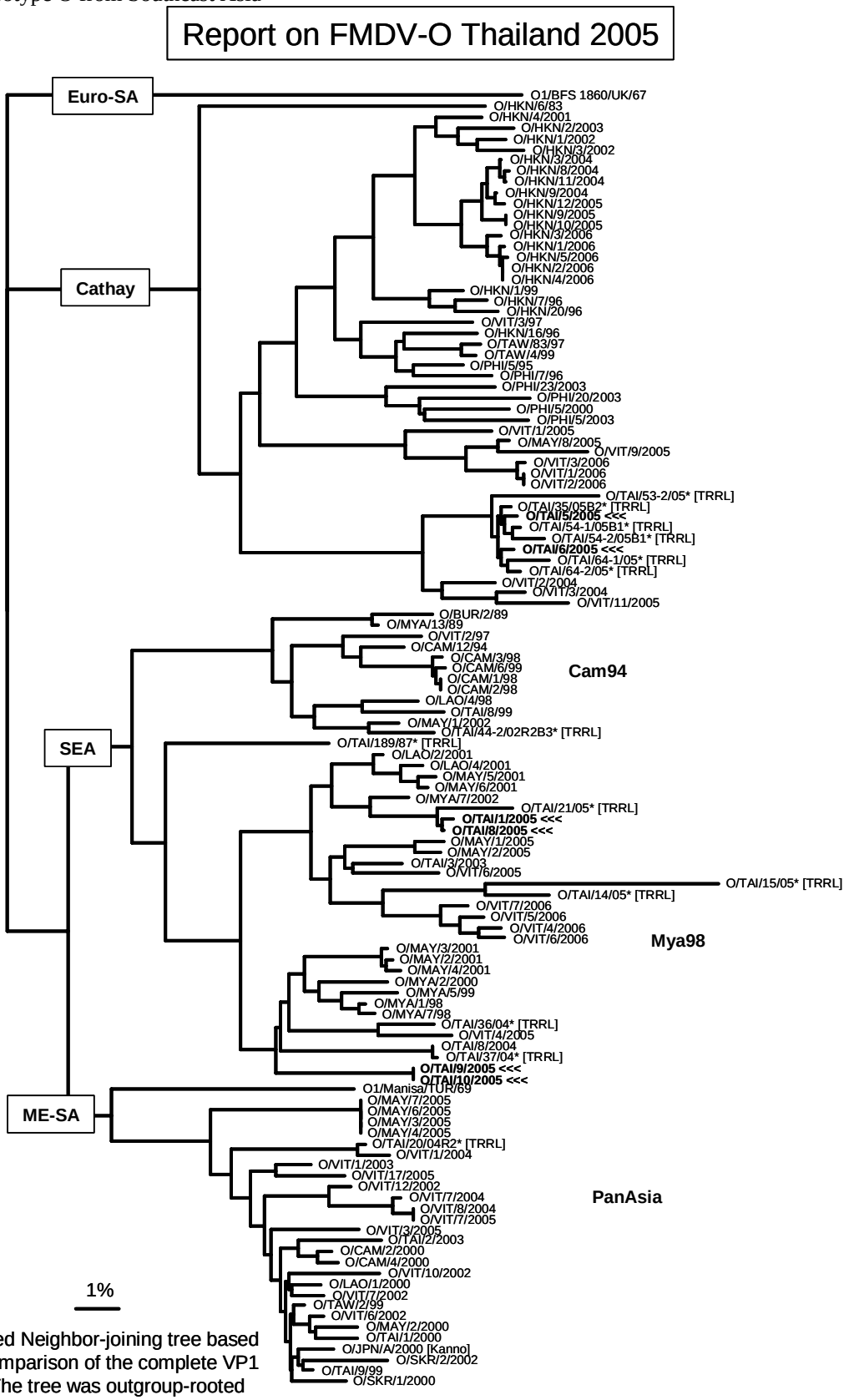
Fig 1 Serotype O FMDV from Kenya



Unrooted Neighbor-joining tree based on a comparison of the complete VP1 gene (~639 nt). The tree was outgroup-rooted using the Euro-SA topotype sequence.
* Not a WRLFMD Ref. No.

N.J. Knowles, J. Wadsworth & K.G. Swabey, 25 September 2006

Fig 2 Serotype O from Southeast Asia



Unrooted Neighbor-joining tree based on a comparison of the complete VP1 gene. The tree was outgroup-rooted using O1/BFS 1860/UK/67.

N.J. Knowles, J. Wadsworth & K.G. Swabey, 19 September 2006

Fig 3 Serotype Asia 1 from South East Asia

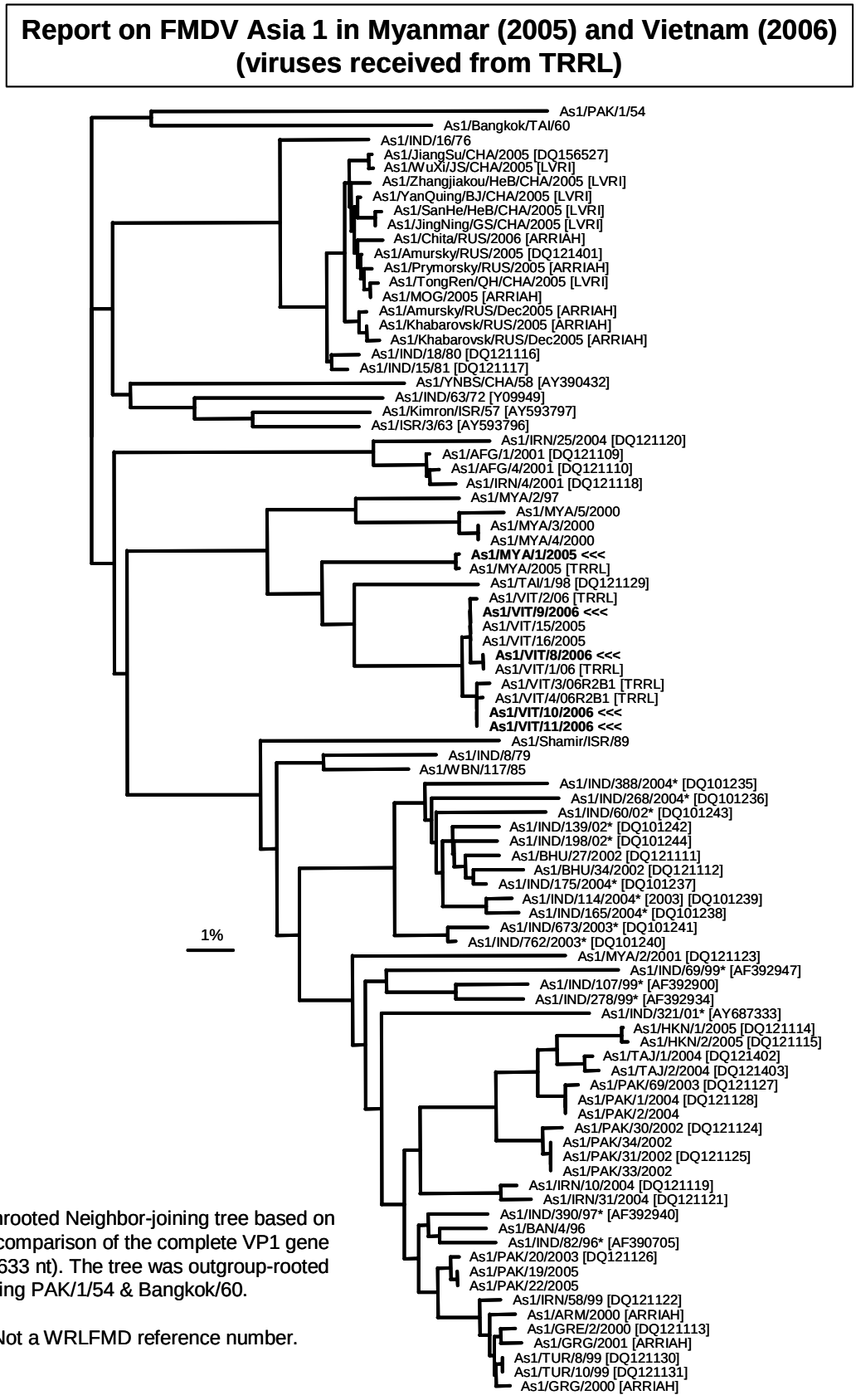
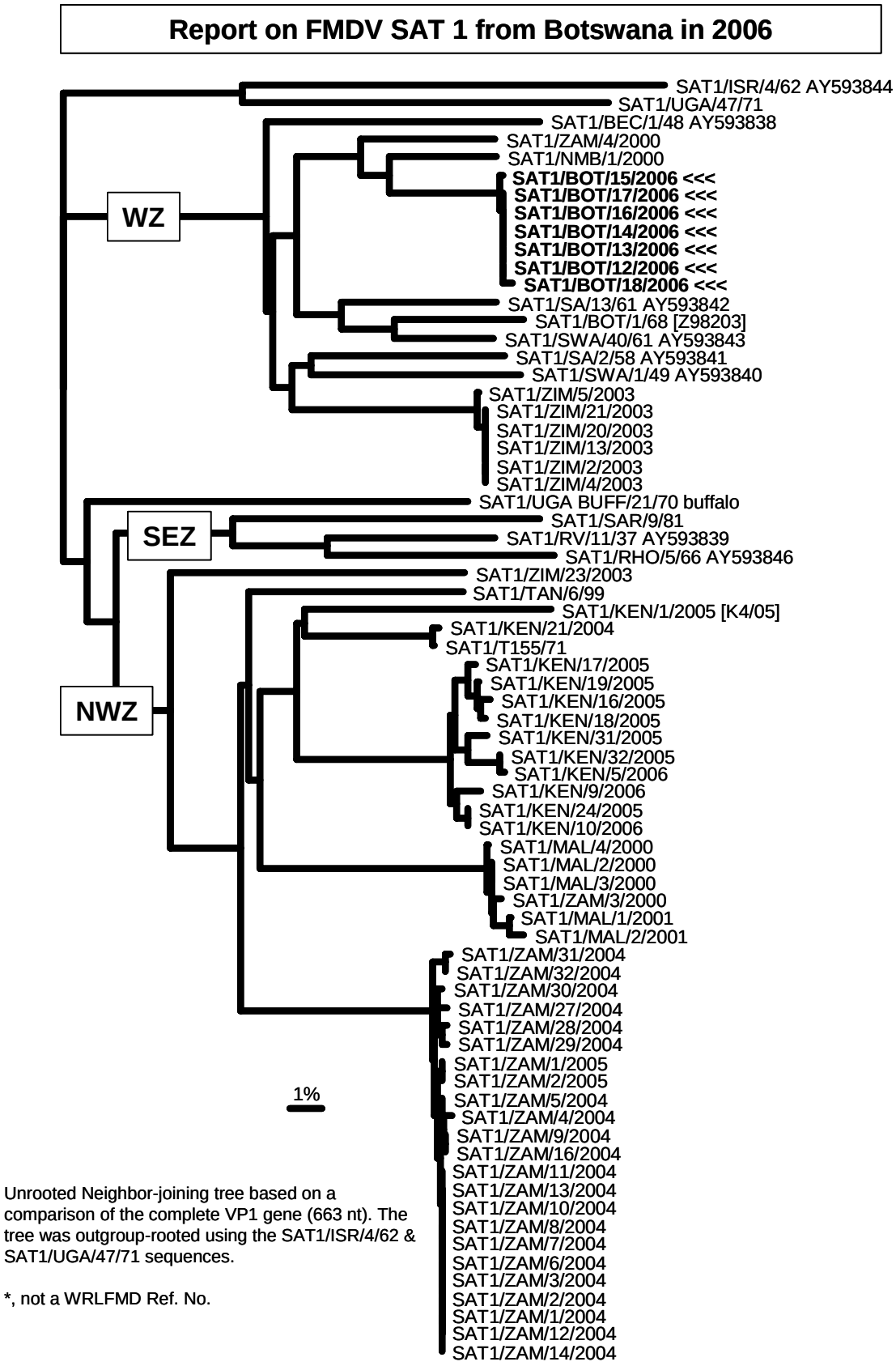


Fig 4 Serotype SAT1 from Botswana



Annex 3. Recent FMD Publications cited by PubMed

1: Li YG, Tian FL, Gao FS, Tang XS, Xia C.
Immune responses generated by Lactobacillus as a carrier in DNA immunization against foot-and-mouth disease virus.
Vaccine. 2006 Sep 20; [Epub ahead of print]
PMID: 17028078 [PubMed - as supplied by publisher]

2: Ellingham M, Bunka DH, Rowlands DJ, Stonehouse NJ.
Selection and characterization of RNA aptamers to the RNA-dependent RNA polymerase from foot-and-mouth disease virus.
RNA. 2006 Oct 3; [Epub ahead of print]
PMID: 17018573 [PubMed - as supplied by publisher]

3: Green DM, Kiss IZ, Kao RR.
Modelling the initial spread of foot-and-mouth disease through animal movements.
Proc Biol Sci. 2006 Aug 1; [Epub ahead of print]
PMID: 17015320 [PubMed - as supplied by publisher]

4: Wessels E, Duijsings D, Lanke KH, van Dooren SH, Jackson CL, Melchers WJ, van Kuppeveld FJ.
Effects of picornavirus 3A proteins on protein transport and GBF1-dependent COP-I recruitment.
J Virol. 2006 Sep 27; [Epub ahead of print]
PMID: 17005635 [PubMed - as supplied by publisher]

5: Yu X, Xiao S, Fang L, Jiang Y, Chen H.
Enhanced immunogenicity to food-and-mouth disease virus in mice vaccination with alphaviral replicon-based DNA vaccine expressing the capsid precursor polypeptide (P1).
Virus Genes. 2006 Dec;33(3):337-44.
PMID: 16991005 [PubMed - in process]

6: Ferris NP, King DP, Reid SM, Shaw AE, Hutchings GH.
Comparisons of original laboratory results and retrospective analysis by real-time reverse transcriptase-PCR of virological samples collected from confirmed cases of foot-and-mouth disease in the UK in 2001.
Vet Rec. 2006 Sep 16;159(12):373-8.
PMID: 16980522 [PubMed - in process]

7: Curry S, Roque-Rosell N, Zunszain PA, Leatherbarrow RJ.
Foot-and-mouth disease virus 3C protease: Recent structural and functional insights into an antiviral target.
Int J Biochem Cell Biol. 2006 Aug 14; [Epub ahead of print]
PMID: 16979372 [PubMed - as supplied by publisher]

8: Nayak A, Goodfellow IG, Woolaway KE, Birtley J, Curry S, Belsham GJ.
Role of RNA structure and RNA binding activity of foot-and-mouth disease virus 3C protein in VPg uridylylation and virus replication.
J Virol. 2006 Oct;80(19):9865-75.
PMID: 16973591 [PubMed - in process]

9: Burman A, Clark S, Abrescia NG, Fry EE, Stuart DI, Jackson T.
Specificity of the VP1 GH loop of Foot-and-Mouth Disease virus for alphav integrins.
J Virol. 2006 Oct;80(19):9798-810.
PMID: 16973584 [PubMed - in process]

10: Heath L, van der Walt E, Varsani A, Martin DP.
Recombination patterns in aphthoviruses mirror those found in other picornaviruses.

J Virol. 2006 Sep 13; [Epub ahead of print]
PMID: 16971423 [PubMed - as supplied by publisher]

11: Cottam EM, Haydon DT, Paton DJ, Gloster J, Wilesmith JW, Ferris NP, Hutchings GH, King DP.
Molecular epidemiology of the foot-and-mouth disease virus outbreak in the United Kingdom in 2001.
J Virol. 2006 Sep 13; [Epub ahead of print]
PMID: 16971422 [PubMed - as supplied by publisher]

12: Serrano P, Pulido MR, Saiz M, Martinez-Salas E.
The 3' end of the foot-and-mouth disease virus genome establishes two distinct long-range RNA-RNA interactions with the 5' end region.
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Annex 4. RECOMMENDATIONS FROM THE WRL ON FMD VIRUS STRAINS TO BE INCLUDED IN FMDV ANTIGEN BANKS – September 2006

High Priority

O Manisa (*covers panasian topotype)*
O BFS or Campos
A24 Cruzeiro
Asia 1 Shamir
A Iran ’96
A22 Iraq
SAT 2 Saudi Arabia *(or equivalent)*
(not in order of importance)

Medium Priority

A Eritrea
SAT 2 Zimbabwe
AIran 87 or A Saudi Arabia 23/86 *(or equivalent)*
SAT 1 South Africa
A Malaysia 97 *(or Thai equivalent such as A/NPT/TAI/86)*
A Argentina 2001
O Taiwan 97 *(pig-adapted strain or Philippine equivalent)*
A Iran ’99 (not in order of importance)

Low Priority

A15 Bangkok related strain
A87 Argentina related strain
C Noville
SAT 2 Kenya
SAT 1 Kenya
SAT 3 Zimbabwe
A Kenya (not in order of importance)