

FAO/OIE Reference Laboratory Report
April-June 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 April and June 2006.

Outbreaks of a new strain of serotype A FMDV that appeared in the European buffer zone of Turkish Thrace in January 2006 appear to have been largely brought under control by emergency vaccination with locally produced A22 Mahmatli vaccine during March, although a further outbreak was reported in June.

FMDV type A that was reported for the first time in Egypt in February 2006 has affected a large number of cattle before locally produced homologous vaccine could be produced. Based on serological vaccine matching tests, none of the existing vaccines stored as antigens in the EU and UK vaccine bank look suitable to protect against this strain, but the Merial vaccine A Eritrea 98 appears to be suitable.

FMDV type SAT 2 was reported in a formerly FMD-free zone in Botswana in April 2006 leading to cessation of trade with Europe and instigation of vaccination using vaccine prepared at the Botswana Vaccine Institute in Gaborone. Recently, FMDV SAT 1 was also reported from Northern Botswana from a part of the country where FMDV outbreaks are more common.

In South America, the outbreaks of type O FMDV in Northern Argentina in the state of Corrientes were reported to be ended. In April 2006, an outbreak of FMDV O was reported in Mato Grosso do Sul, Southern Brazil; however, this appears to be under control and surveillance is being performed. Further north, the Brazilian authorities have applied to OIE for FMD-free region status for mid-Para state, just south of the river Amazon. FMDV continues to be reported from some traditionally endemic countries in the region, such as Ecuador (type O).

Despite an apparently improved situation with respect to Asia 1 outbreaks in China, sporadic reports of disease have continued to be reported in May and June 2006. Vietnam is experiencing a serious upsurge in FMDV affecting pigs with high mortality and this is due to outbreaks of the Cathay pig-adapted topotype of serotype O. This strain was also reported in Thailand, the first time that it has been identified in Southeast Asia outside the Philippines, Vietnam and China. Asia 1 virus has also been reported in Vietnam, but the strain has affected cattle rather than pigs and is of a lineage indigenous to Southeast Asia and different from that reported in China.

Middle East/southern Asia

FMDV serotype O

The VP1 sequences of 10 FMDV isolates from Pakistan (O/PAK/4, 6, 8-12, 14-16/2006) were all closely related to each other and fell on the PanAsia lineage within the Middle East-South Asia (ME-SA) topotype, being most closely related to the sequences of three Iranian viruses (O/IRN/8-10/2006) (Annex 2; Fig. 1). Two isolates received from Kuwait (O/KUW/2/2006 and O/KUW/3/2006) were closely related to viruses from Saudi Arabia collected in 2005 (Annex 2; Fig. 1). The VP1 sequencing was completed on five Turkish isolates (O/TUR/1-5/2005) which were received during the last reporting period; these fell on another branch of the PanAsia lineage, being most closely related to isolates from Iran and Israel collected in 2004 (Annex 2; Fig. 1). Sequencing is in progress of two samples received from Israel (O/ISR/1/2006 and O/ISR/2/2006) during this reporting period.

FMDV serotype A

A new strain of type A, mentioned in the last report as occurring in Iran (2003-05), Saudi Arabia (2005) and Turkish Thrace (2006), was identified in three samples from Pakistan (A/PAK/1, 3 & 5/2006) and two samples from Iran (A/IRN/5/2006 and A/IRN/7/2006) (Annex 2; Fig. 2). Additionally, 23 type A virus isolates from Iran (A/IRN/22, 24-31, 33-34, 36, 38-40, 42-44, 50-51 & 53-55/2005), received in September and December 2005, were also identified as belonging to the new lineage (Annex 2; Fig. 2). Similarly, seven viruses isolated from Turkey in 2005 (A/TUR/6-12/2005) also belonged to the new group (Annex 2; Fig. 2).

Southeast Asia and the Far East

FMDV serotype O

The VP1 sequences of 13 type O virus isolates from Hong Kong (O/HKN/17-20, 22-25/2005 and HKN/1-5/2006) belonged to the Cathay topotypes and were all closely related to each other (Annex 2; Fig. 3). Nine

VP1 sequences were received from the OIE FMD Regional Reference Laboratory (RRL) in Thailand. Three were from viruses isolated from cattle and belonged to the Southeast Asia (SEA) topotype (Annex 2; Fig. 3). The remaining six sequences were from isolates from pigs and belonged to the Cathay topotype (Annex 2; Fig. 3). This is the first known occurrence of this topotype in Thailand. Fifteen type O isolates collected in Vietnam between 2004 and 2006 are currently being sequenced and preliminary analyses indicates they belong to three different topotypes, ME-SA, SEA or Cathay (Table 1).

TABLE 1. Preliminary genetic identification of 15 FMDV type O isolates from Vietnam.

WRLFMD Ref. No.	Species	Address	Date Collected	Topotype*	Strain
O/VIT/7/2004	Cattle	Khanh Hoa	16/10/2004	ME-SA*	PanAsia
O/VIT/8/2004	Cattle	Khanh Hoa	16/10/2004	ME-SA	PanAsia
O/VIT/6/2005	Cattle	Quang Ngai	18/03/2005	SEA†	Mya98
O/VIT/7/2005	Cattle	Quang Ngai	18/03/2005	ME-SA	PanAsia
O/VIT/9/2005	Pig	Hai Duong	30/05/2005	Cathay	
O/VIT/11/2005	Pig	Hah Giang	18/06/2005	Cathay	
O/VIT/12/2005	Pig	Long An	28/07/2005	Cathay	
O/VIT/17/2005	Cattle	Can Tho	10/11/2005	ME-SA	PanAsia
O/VIT/1/2006	Pig	Long An	01/01/2006	Cathay	
O/VIT/2/2006	Pig	Dong Thap	11/01/2006	Cathay	
O/VIT/3/2006	Pig	Tien Giang	12/01/2006	Cathay	
O/VIT/4/2006	Pig	Binh Dinh	08/02/2006	SEA	Mya98
O/VIT/5/2006	Cattle	Binh Dinh	17/02/2006	SEA	Mya98
O/VIT/6/2006	Pig	Phu Yen	01/03/2006	SEA	Mya98
O/VIT/7/2006	Cattle	Phu Yen	01/03/2006	SEA	Mya98

* ME-SA = Middle East/South Asia

† SEA = Southeast Asia

FMDV serotype A

The VP1 sequences of 10 viruses from Vietnam (A/VIT/6, 9-12/2004, A/VIT/8, 10, 13, 14 & 18/2005) were related to sequences of viruses from Thailand, Malaysia and Laos from 2003 and 2004 (Annex 2; Fig. 4).

FMDV serotype Asia 1

The sequences of two Asia 1 isolates (Asia1/VIT/15 & 16/2005) and two VP1 sequences of Vietnamese isolates received from the Thailand RRL were all closely related to each other and next most closely to viruses from Thailand (1998) and Myanmar (2005) (Annex 2; Fig. 5). This lineage only occurs in Southeast Asia and is distinct from other Asia 1 viruses circulating in other Asian countries.

Africa

FMDV serotype A

Three isolates from Egypt (A/EGY/3-5/2006), received during the previous reporting period were closely related to viruses submitted from that country in February 2006 (Annex 2; Fig. 6). These are not closely related to the new type A strain circulating in Asia (Iran, Saudi Arabia, Pakistan and Turkey).

FMDV serotype SAT 2

Three samples received from Botswana (SAT2/BOT/1, 5 & 8/2006) were sequenced and shown to be closely related to viruses from previous outbreaks in Zimbabwe in 2001-02 and Botswana in 2002 (Annex 2; Fig. 7). They were distinct from viruses causing an outbreak in Botswana in 2005 (Annex 2; Fig. 7). Five VP1 sequences were obtained for viruses submitted from Kenya during the last reporting period. They fell into two groups, i) Central Province – SAT2/KEN/7/2005 and ii) Central Province – SAT2/KEN/13/2004, Eastern Province – SAT2/ETH/17/2004 and Rift Valley Province – SAT2/KEN/22/2004 & SAT2/KEN/8/2005.

Sequencing is in progress for all samples not mentioned here which were received during the reporting period.

Vaccine matching

FMD isolates of serotype A (Vietnam, Egypt, Turkey and Saudi Arabia), O (Kuwait and Vietnam), Asia 1 (Vietnam) and SAT2 (Botswana and Kenya) collected between 2004 and 2006 were further characterized by VNT (Annex 1; TABLE C). This confirmed the utility of O₁ Manisa to all serotype O isolates tested, except for an isolate from Vietnam (VIT 12/2005) which is classified (by VP1 sequencing: see Table 1) as a member of the Cathay toptotype.

The type A viruses from the 2006 outbreak in Egypt described in the previous report, were further tested and showed a match by VNT to A Eritrea. The European Commission for Control of FMD is funding a potency test at the Friedrich Loeffler Institute in Germany in August, to test whether A22 Iraq vaccine antigen held by the EU vaccine bank can protect against A Egypt 2006, despite a poor predicted match by serological tests. Further A isolates from Asia (Middle East: Turkey and Saudi Arabia) did not match with this vaccine strain. A isolates from Vietnam were most closely matched to A May97 but are not covered by A22, A Irn 96, A Eritrea or A15 reference vaccine strains.

Two isolates of Asia 1 (also from Vietnam) had a closest relationship with vaccine strain Asia 1 Shamir.

The African SAT2 isolates tested all matched with the SAT2 Eritrea reference vaccine strain.

A new recommendation on vaccine strains has been provided by the FMD FAO World Reference Laboratory to the Executive Committee of the European Commission for the Control of FMD (Annex 4). A22 Iraq has been moved from medium to high priority and A Eritrea 98 from low to medium priority.

Publication of data to the Scientific Community

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

Brocchi E, Bergmann IE, Dekker A, Paton DJ, Sammin DJ, Greiner M, Grazioli S, De Simone F, Yadin H, Haas B, Bulut N, Malirat V, Neitzert E, Goris N, Parida S, Sorensen K, De Clercq K. Comparative evaluation of six ELISAs for the detection of antibodies to the non-structural proteins of foot-and-mouth disease virus. Vaccine. 2006 May 6; [Epub ahead of print]

Cox SJ, Voyce C, Parida S, Reid SM, Hamblin PA, Hutchings G, Paton DJ, Barnett PV. Effect of emergency FMD vaccine antigen payload on protection, sub-clinical infection and persistence following direct contact challenge of cattle. Vaccine. 2006 Apr 12;24(16):3184-90. Epub 2006 Jan 30.

Dukes JP, King DP, Alexandersen S. Novel reverse transcription loop-mediated isothermal amplification for rapid detection of foot-and-mouth disease virus. Arch Virol. 2006 Jun;151(6):1093-106. Epub 2006 Feb 2.

Li Y, Aggarwal N, Takamatsu HH, Sterling CM, Voyce C, Barnett PV. Enhancing immune responses against a plasmid DNA vaccine encoding a FMDV empty capsid from serotype O. Vaccine. 2006 May 22;24(21):4602-6. Epub 2005 Aug 24.

Takamatsu HH, Denyer MS, Stirling C, Cox S, Aggarwal N, Dash P, Wileman TE, Barnett PV. Porcine gammadelta T cells: Possible roles on the innate and adaptive immune responses following virus infection. Vet Immunol Immunopathol. 2006 Jul 15;112(1-2):49-61. Epub 2006 May 22.

Annex 1.

Table A: Summary of clinical sample diagnostics made by the WRL between April – June 2006

Country	WRL for FMD Sample Identification	Animal	Date of Collection	Results		
				VI/ELISA	RT-PCR	Final report
HONG KONG	HKN 17/2005	Pig**	04.07.05	O	Positive	O
	HKN 18/2005	Pig	04.07.05	O	Positive	O
	HKN 19/2005	Pig	04.07.05	O	Positive	O
	HKN 20/2005	Pig	04.07.05	O	Positive	O
	HKN 21/2005	Pig	01.08.05	NVD	Negative	NVD
	HKN 22/2005	Pig	15.11.05	O	Positive	O
	HKN 23/2005	Pig	15.11.05	O	Positive	O
	HKN 24/2005	Pig	21.11.05	O	Positive	O
	HKN 25/2005	Pig	21.11.05	O	Positive	O
	HKN 26/2005	Pig	21.11.05	NVD	Positive	FMDV GD
	HKN 1/2006	Pig	26.01.06	O	Positive	O
	HKN 2/2006	Pig	26.01.06	O	Positive	O
	HKN 3/2006	Pig	26.01.06	O	Positive	O
	HKN 4/2006	Pig	26.01.06	O	Positive	O
	HKN 5/2006	Pig	26.01.06	O	Positive	O
KUWAIT	KUW 1/2006	NK	NK	NVD	Negative	NVD
	KUW 2/2006	NK	NK	O	Positive	O
	KUW 3/2006	NK	NK	O	Positive	O
PAKISTAN	PAK 1/2006	Cattle	31.01.06	A	Positive	A
	PAK 2/2006	Buffalo	31.01.06	NVD	Positive	FMDV GD
	PAK 3/2006	Cattle	31.01.06	A	Positive	A
	PAK 4/2006	Cattle	31.01.06	O	Positive	O
	PAK 5/2006	Cattle	31.01.06	A	Positive	A
	PAK 6/2006	Buffalo	31.01.06	O	Positive	O
	PAK 7/2006	Buffalo	07.04.06	NVD	Negative	NVD
	PAK 8/2006	Buffalo	31.01.06	O	Positive	O
	PAK 9/2006	Buffalo	31.01.06	O	Positive	O
	PAK 10/2006	Buffalo	31.01.06	O	Positive	O
	PAK 11/2006	Buffalo	01.02.06	O	Positive	O
	PAK 12/2006	Buffalo	01.02.06	O	Positive	O
	PAK 13/2006	Cattle	01.02.06	NVD	Positive	FMDV GD
	PAK 14/2006	Cattle	01.02.06	O	Positive	O
	PAK 15/2006	Cattle	07.04.06	O	Positive	O
	PAK 16/2006	Cattle	31.01.06	O	Positive	O
VIETNAM	VIT 6/2004	Cattle	22.09.04	A	Positive	A
	VIT 7/2004	Cattle	16.10.04	O	Positive	O
	VIT 8/2004	Cattle	16.10.04	O	Positive	O
	VIT 9/2004	Cattle	29.10.04	A	Positive	A
	VIT 10/2004	Cattle	01.11.04	A	Positive	A
	VIT 11/2004	Cattle	02.11.04	A	Positive	A
	VIT 12/2004	Cattle	24.12.04	A	Positive	A
	VIT 6/2005	Cattle	18.03.05	O	Positive	O

Country	WRL for FMD Sample Identification	Animal	Date of Collection	Results		
				VI/ELISA	RT-PCR	Final report
	VIT 7/2005	Cattle	18.03.05	O	Positive	O
	VIT 8/2005	Cattle	07.05.05	A	Positive	A
	VIT 9/2005	Pig	30.05.05	O	Positive	O
	VIT 10/2005	Cattle	01.06.05	A	Positive	A
	VIT 11/2005	Pig	18.06.05	O	Positive	O
	VIT 12/2005	Pig	28.07.05	O	Positive	O
	VIT 13/2005	Cattle	31.07.05	A	Positive	A
	VIT 14/2005	Cattle	13.08.05	A	Positive	A
	VIT 15/2005	Cattle	18.10.05	Asia 1	Positive	Asia 1
	VIT 16/2005	Cattle	27.10.05	Asia 1	Positive	Asia 1
	VIT 17/2005	Cattle	10.11.05	O	Positive	O
	VIT 18/2005	Cattle	07.12.05	A	Positive	A
	VIT 1/2006	Pig	01.01.06	O	Positive	O
	VIT 2/2006	Pig	11.01.06	O	Positive	O
	VIT 3/2006	Pig	12.01.06	O	Positive	O
	VIT 4/2006	Pig	08.02.06	O	Positive	O
	VIT 5/2006	Cattle	17.02.06	O	Positive	O
	VIT 6/2006	Pig	01.03.06	O	Positive	O
	VIT 7/2006	Cattle	01.03.06	O	Positive	O
BOTSWANA	BOT 1/2006	Cattle	25.04.06	SAT 2	Positive	SAT 2
	BOT 2/2006	Cattle	25.04.06	NVD	Positive	FMDV GD
	BOT 3/2006	Cattle	25.04.06	NVD	Positive	FMDV GD
	BOT 4/2006	Cattle	25.04.06	NVD	Positive	FMDV GD
	BOT 5/2006	Cattle	25.04.06	SAT 2	Positive	SAT 2
	BOT 6/2006	Cattle	25.04.06	NVD	Positive	FMDV GD
	BOT 7/2006	Cattle	29.04.06	NVD	Positive	FMDV GD
	BOT 8/2006	Cattle	29.04.06	SAT 2	Positive	SAT 2
	BOT 9/2006	Cattle	29.04.06	NVD	Positive	FMDV GD
	BOT 10/2006	Cattle	29.04.06	NVD	Negative	NVD
	BOT 11/2006	Cattle	29.04.06	NVD	Positive	FMDV GD
IRAN	IRN 1/2006	Cattle	14.03.06	NVD	Positive	FMDV GD
	IRN 2/2006	Cattle	07.04.06	NVD	Negative	NVD
	IRN 3/2006	Sheep	09.04.06	NVD	Negative	NVD
	IRN 4/2006	Cattle	12.04.06	NVD	Negative	NVD
	IRN 5/2006	Cattle	18.04.06	A	Positive	A
	IRN 6/2006	Cattle	18.04.06	NVD	Negative	NVD
	IRN 7/2006	Cattle	23.04.06	A	Positive	A
	IRN 8/2006	Cattle	29.04.06	O	Positive	O
	IRN 9/2006	Cattle	09.05.06	O	Positive	O
	IRN 10/2006	Cattle	09.05.06	O	Positive	O
KENYA	KEN 31/2004	Cattle	20.02.04	NVD	Positive	FMDV GD
	KEN 32/2004	Cattle	23.02.04	SAT 2	Positive	SAT 2
	KEN 33/2004	Cattle	08.03.04	NVD	Negative	NVD
	KEN 34/2004	Cattle	19.03.04	NVD	Positive	FMDV GD
	KEN 35/2004	Cattle	29.04.04	NVD	Positive	FMDV GD
	KEN 36/2004	Cattle	11.05.04	NVD	Positive	FMDV GD
	KEN 37/2004	Cattle	25.05.04	NVD	Positive	FMDV GD
	KEN 20/2005	Cattle	20.01.05	NVD	Positive	FMDV GD

Country	WRL for FMD Sample Identification	Animal	Date of Collection	Results VI/ELISA	Country RT-PCR	WRL for FMD Final report
	KEN 21/2005	Cattle	28.01.05	NVD	Positive	FMDV GD
	KEN 22/2005	Cattle	22.03.05	NVD	Positive	FMDV GD
	KEN 23/2005	Cattle	10.04.05	NVD	Positive	FMDV GD
	KEN 24/2005	Cattle	19.05.05	SAT 1	Positive	SAT 1
	KEN 25/2005	Cattle	20.05.05	NVD	Positive	FMDV GD
	KEN 26/2005	Cattle	27.05.05	O	Positive	O
	KEN 27/2005	Cattle	15.07.05	O	Positive	O
	KEN 28/2005	Cattle	28.07.05	NVD	Positive	FMDV GD
	KEN 29/2005	Cattle	24.08.05	A	Positive	A
	KEN 30/2005	Cattle	02.09.05	NVD	Positive	FMDV GD
	KEN 31/2005	Cattle	19.09.05	SAT 1	Positive	SAT 1
	KEN 32/2005	Cattle	23.09.05	SAT 1	Positive	SAT 1
	KEN 1/2006	Cattle	11.01.06	NVD	Positive	FMDV GD
	KEN 2/2006	Cattle	20.01.06	NVD	Positive	FMDV GD
	KEN 3/2006	Cattle	24.01.06	A	Positive	A
	KEN 4/2006	Cattle	25.01.06	NVD	Positive	FMDV GD
	KEN 5/2006	Cattle	02.02.06	SAT 1	Positive	SAT 1
	KEN 6/2006	Cattle	14.02.06	NVD	Positive	FMDV GD
	KEN 7/2006	Cattle	21.02.06	NVD	Negative	NVD
	KEN 8/2006	Cattle	21.02.06	NVD	Negative	NVD
	KEN 9/2006	Cattle	29.03.06	SAT 1	Positive	SAT 1
	KEN 10/2006	Cattle	09.05.06	SAT 1	Positive	SAT 1
RWANDA	RWA 1/2006	Cattle	26.04.06	NVD	Negative	NVD

TOTAL: 115

* Institute for Animal Health, Pirbright Laboratory, Woking, Surrey GU24 0NF

FMDV foot-and-mouth disease virus

VI/ELISA FMDV serotype identified following virus isolation in cell culture and antigen detection ELISA

RT-PCR reverse transcription polymerase chain reaction on epithelial suspension for FMD viral genome

NVD no foot-and-mouth disease, swine vesicular disease or vesicular stomatitis virus detected

NK not known

NPF, 7 June 2006

TABLE B: Summary of samples received during the previous reporting period (Jan – Mar 2006)

Country	No. of samples	Virus isolation in cell culture/ELISA							SVD virus	NVD	RT-PCR for FMD (or SVD) virus (where appropriate)	
		O	A	C	FMD virus serotypes			Asia			Positive	Negative
					SAT 1	SAT 2	SAT 3					
EGYPT	5	-	5	-	-	-	-	-	-	5	-	
ISRAEL	7	7	-	-	-	-	-	-	-	7	-	
KENYA	36	8	1	-	7	5	-	-	-	15	3	
RWANDA	1	-	-	-	-	-	-	-	-	1	1	
SAUDI ARABIA	2	-	2	-	-	-	-	-	-	-	2	
SENEGAL	9	1	-	-	-	-	-	-	-	8	9	
TURKEY	15	5	10	-	-	-	-	-	-	-	15	
TOTAL	75	21	18	-	7	5	-	-	-	24	13	

* 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, 3 April 2006

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

	A22 Iraq	A Irn96	A May97	A Eritrea	A15
	vnt	vnt	vnt	vnt	vnt
A Vit 06/04	0.20	0.11	0.31	0.09	0.10
A Vit 10/04	0.26	0.15	0.31	0.11	0.12
A Vit 08/05	0.09	0.15	0.51	0.11	0.16
A Vit 18/05	0.07	0.20	0.36	0.10	0.18
A Egy 01/06				0.45	
A Egy 02/06				0.41	
A Sau 15/05				0.14	
A Sau 16/05				0.14	
A Tur 01/06				0.15	
A Tur 02/06				0.15	
	O Manisa	O Lausanne			As Ind 8/79
	vnt	vnt		vnt	As Shamir
O Kuw 02/06	>0.80	0.69	Asia1 Vit 15/2005	0.25	0.36
O Kuw 03/06	0.74	0.57	Asia1 Vit 16/2005	0.24	0.39
O Vit 01/06	0.33				
O Vit 07/04	>1.0				
O Vit 12/05	0.19				
	Sat2 Eritrea				
	vnt				
Sat2 Bot 01/05	0.51				
Sat2 Bot 02/05	0.48				
Sat2 Ken 13/04	0.93				
Sat2 Ken 17/04	0.65				
Sat2 Ken 22/04	0.63				
Sat2 Ken 07/05	0.45				
Sat2 Ken 08/05	0.74				

grey figures are one observation only

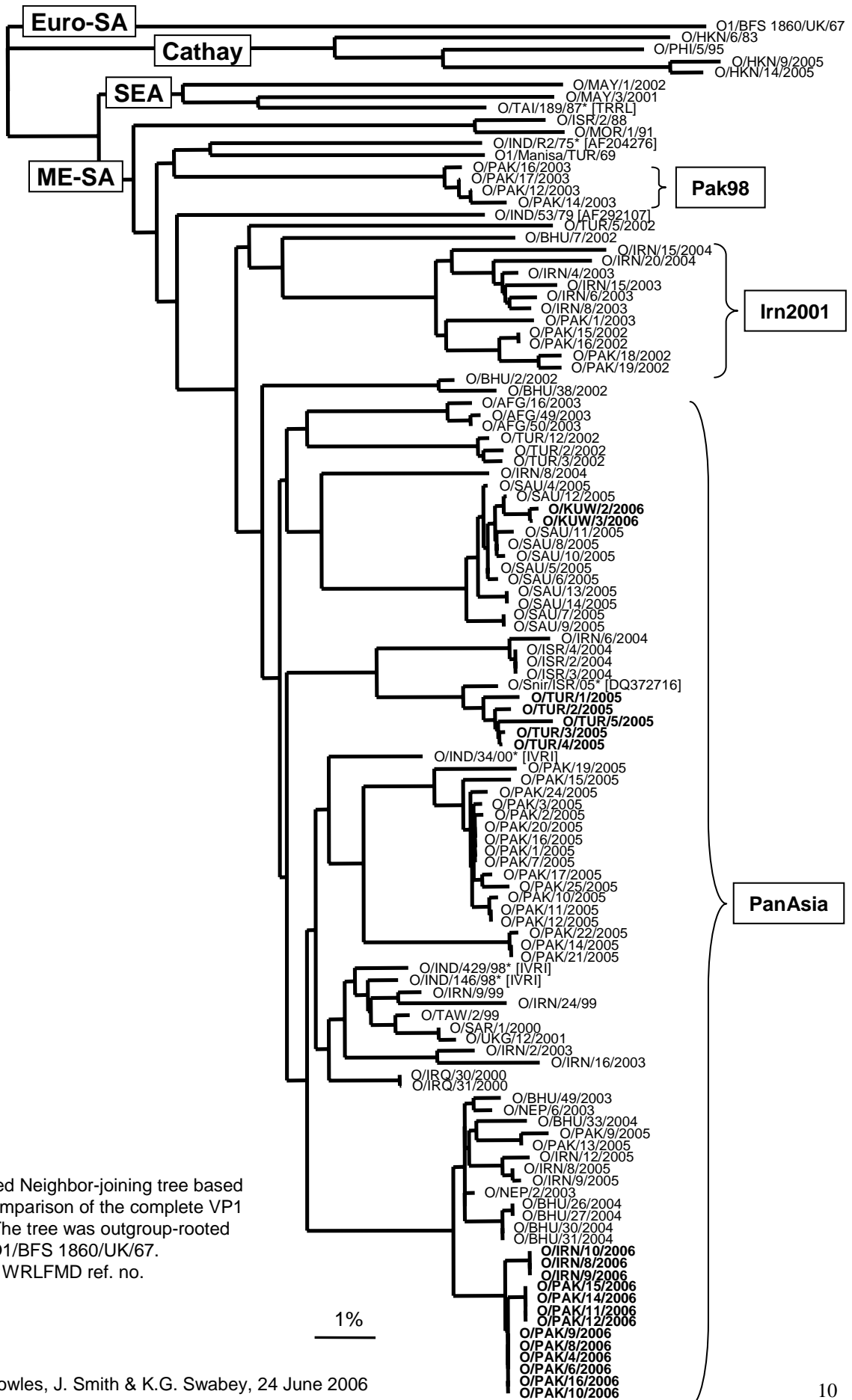
Interpretation of r_1 values

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.

Fig. 1. Genetic relationships between southern Asian foot-and-mouth disease type O viruses.



Unrooted Neighbor-joining tree based on a comparison of the complete VP1 gene. The tree was outgroup-rooted using O1/BFS 1860/UK/67.
*, not a WRLFMD ref. no.

Fig. 2. Genetic relationships between southern Asian foot-and-mouth disease type A viruses.

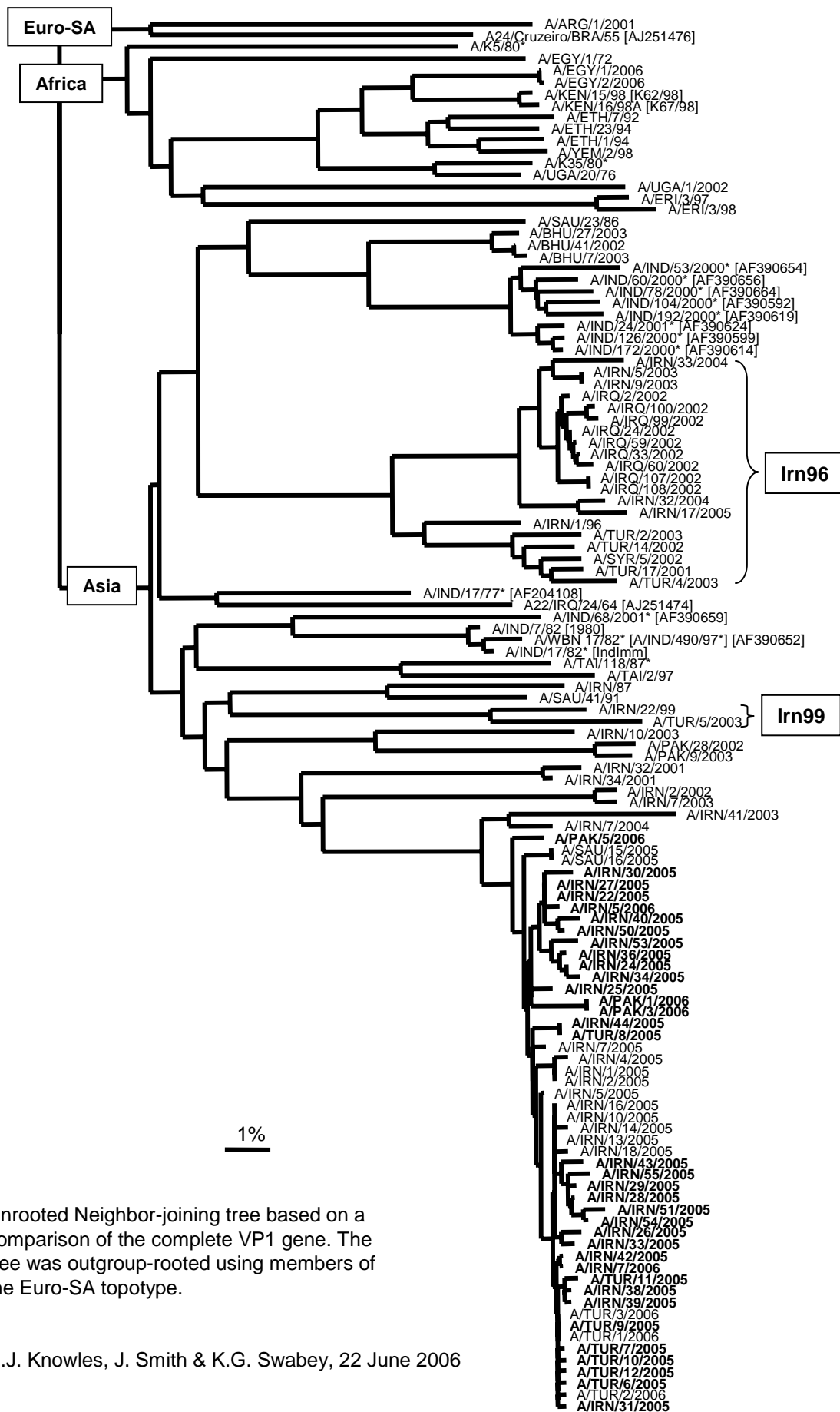
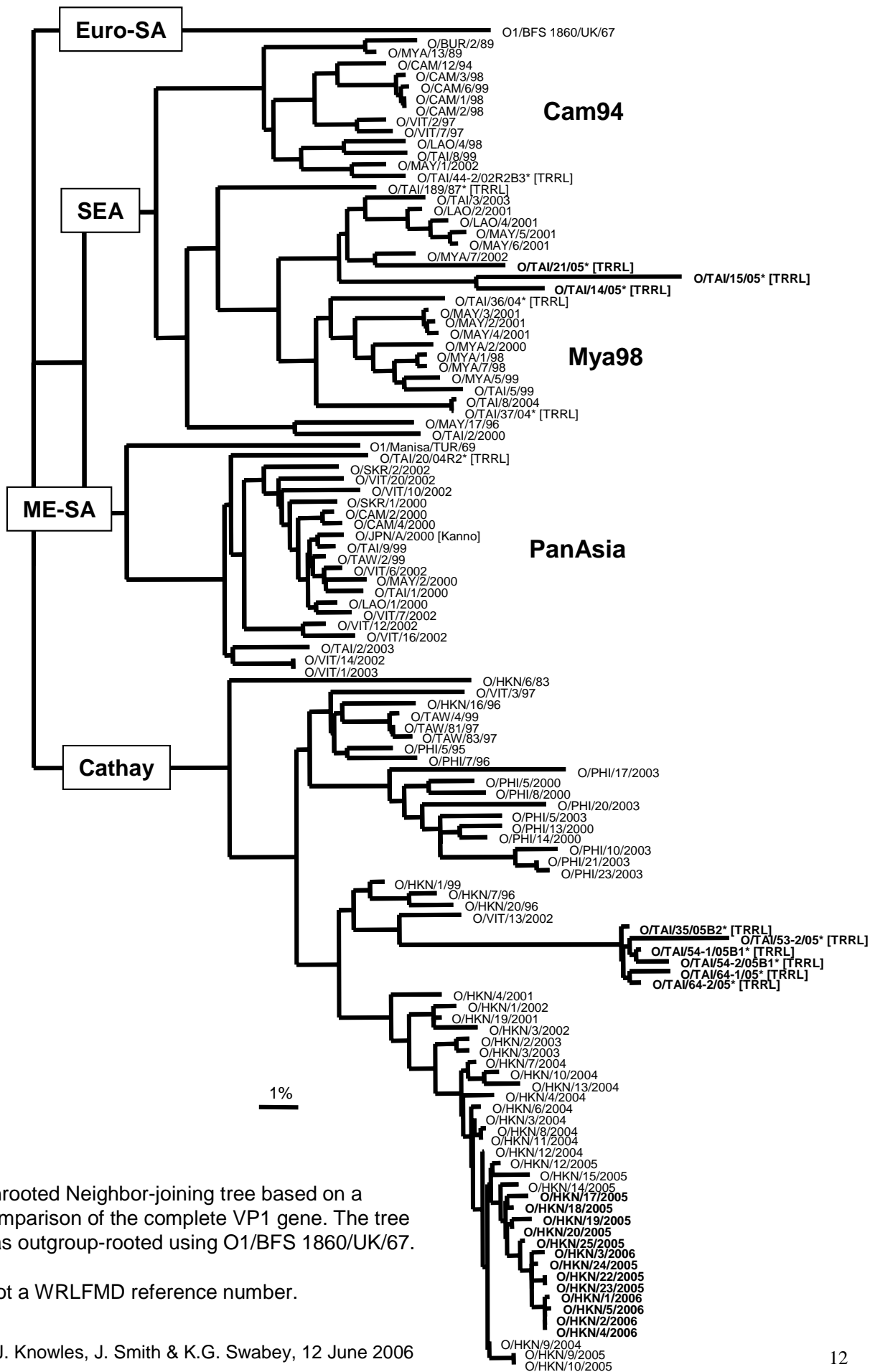


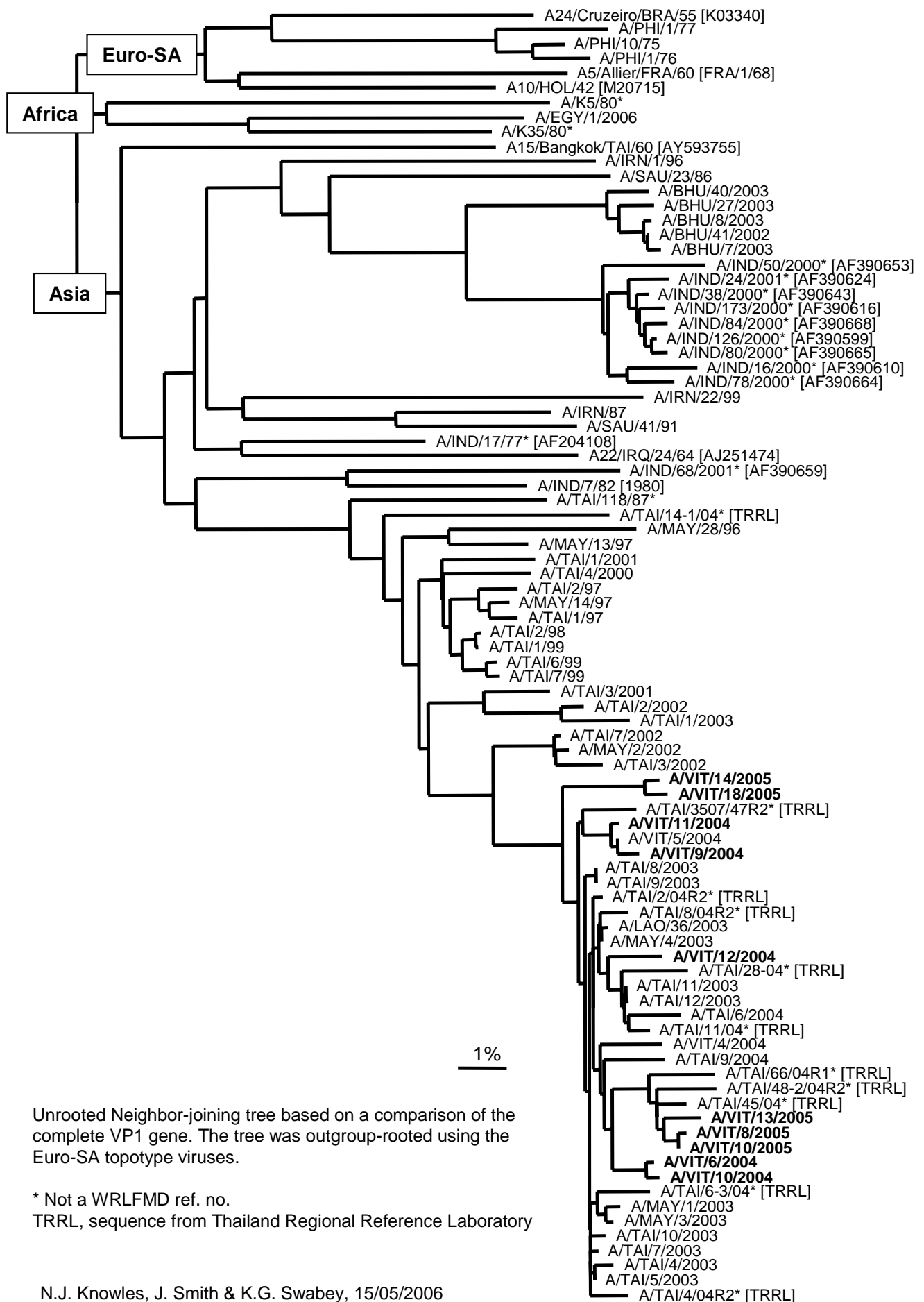
Fig. 3. Genetic relationships between Southeast Asian foot-and-mouth disease type O viruses.



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

*not a WRLFMD reference number.

Fig. 4. Genetic relationships between Southeast Asian foot-and-mouth disease type A viruses.



Unrooted Neighbor-joining tree based on a comparison of the complete VP1 gene. The tree was outgroup-rooted using the Euro-SA toptotype viruses.

* Not a WRLFMD ref. no.
 TRRL, sequence from Thailand Regional Reference Laboratory

Fig. 5. Genetic relationships between Asian foot-and-mouth disease type Asia 1 viruses.

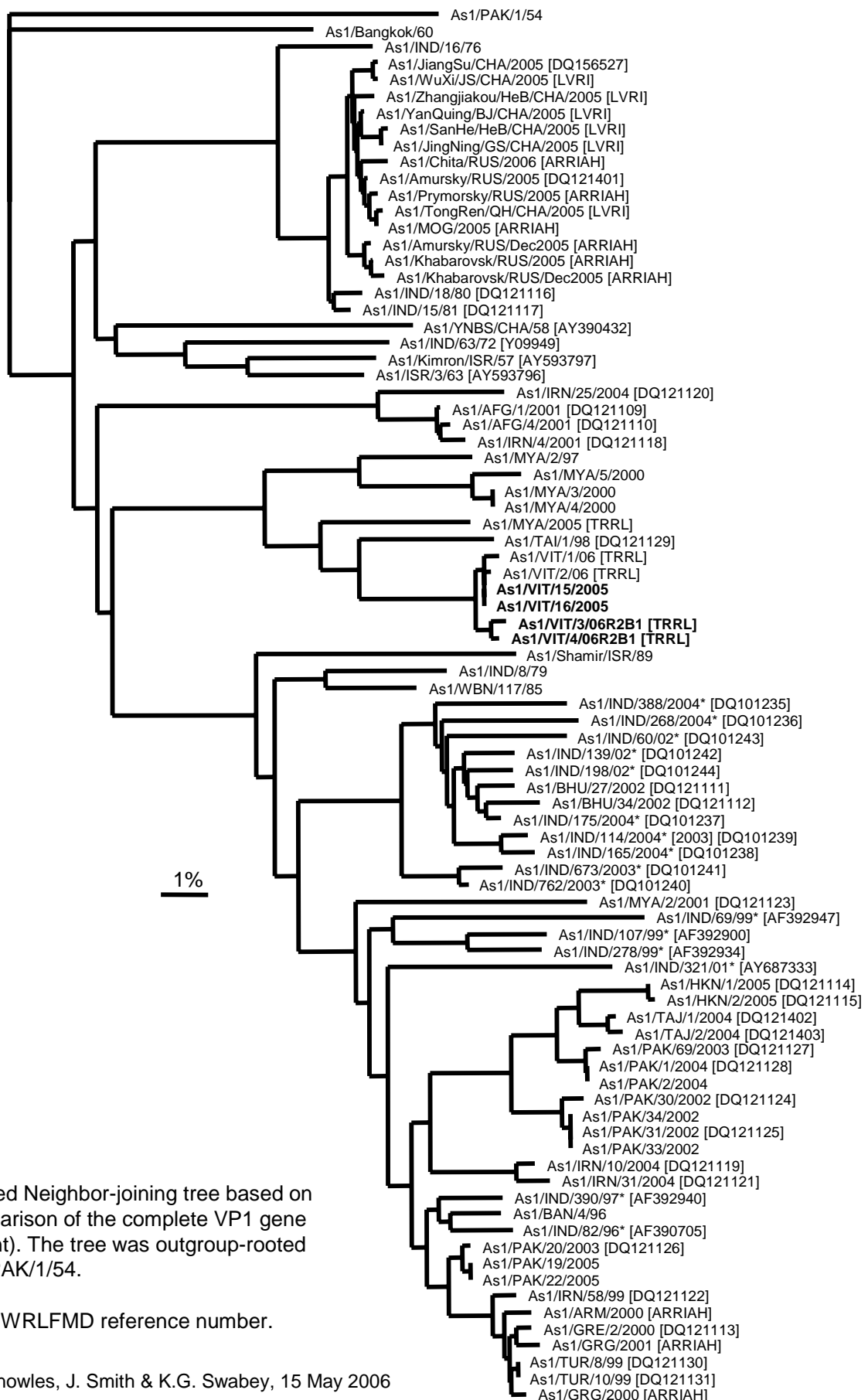
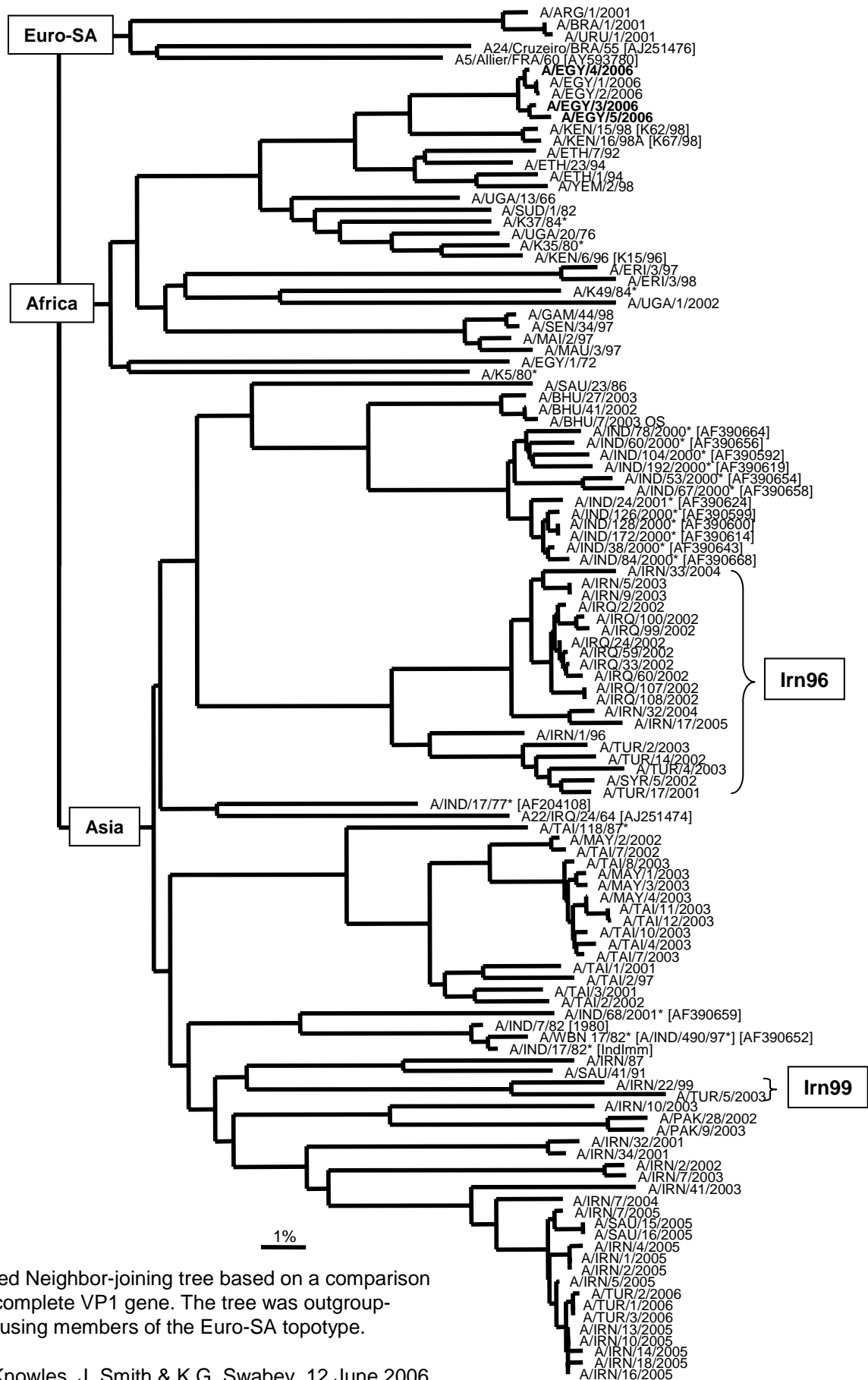


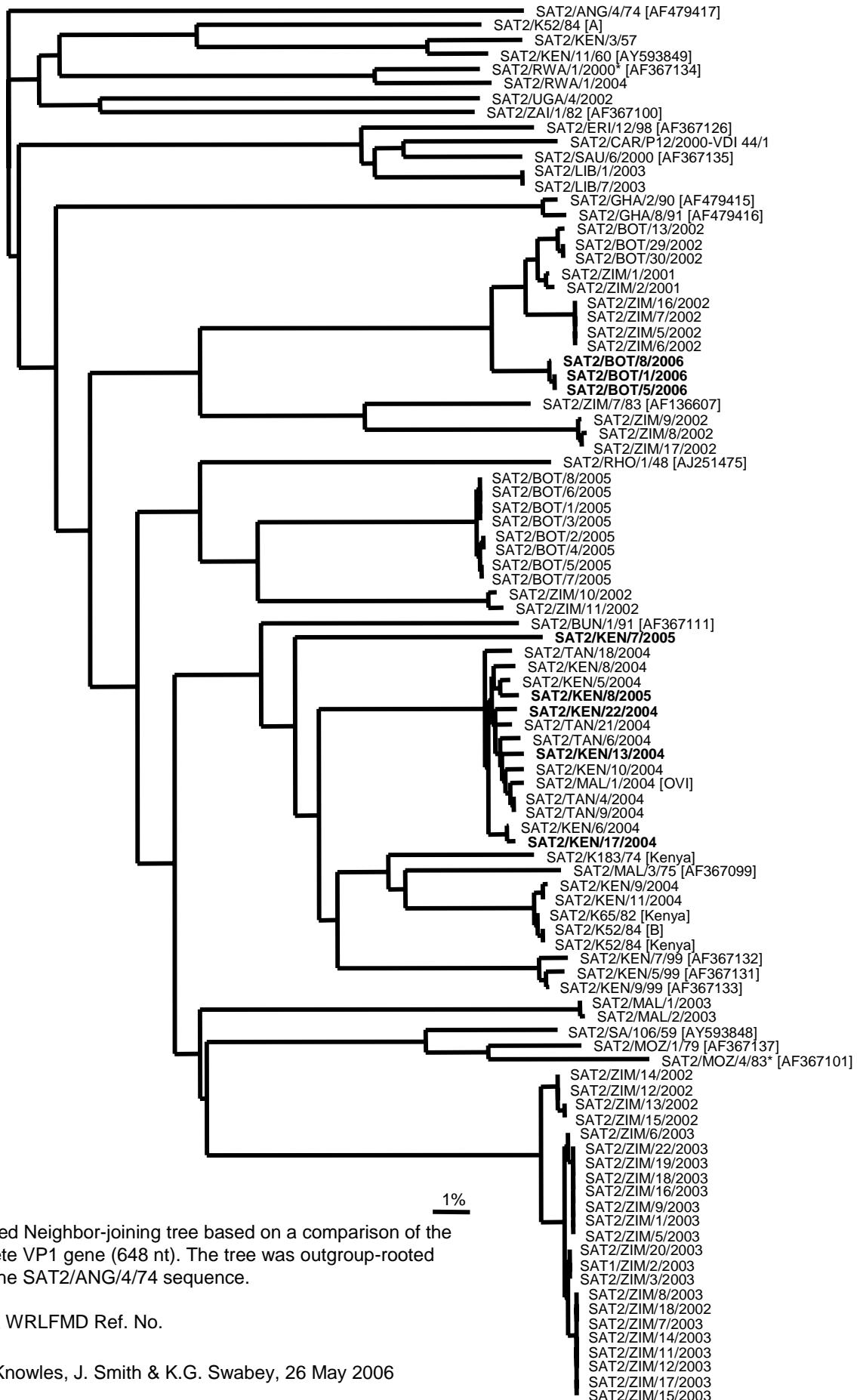
Fig. 6. Genetic relationships between African foot-and-mouth disease type A viruses.



Unrooted Neighbor-joining tree based on a comparison of the complete VP1 gene. The tree was outgroup-rooted using members of the Euro-SA toptotype.

N.J. Knowles, J. Smith & K.G. Swabey, 12 June 2006

Fig. 7. Genetic relationships between African foot-and-mouth disease type SAT 2 viruses.



Annex 3. Recent FMD Publications cited by PubMed

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Annex 4. RECOMMENDATIONS FROM THE WRL ON FMD VIRUS STRAINS TO BE INCLUDED IN FMDV ANTIGEN BANKS – JUNE 2006

High Priority

O Manisa (*covers panasian topotype*)
O BFS or Campos
A24 Cruzeiro
Asia 1 Shamir
A Iran '96
A22 Iraq – **moved from medium to high**
SAT 2 Saudi Arabia (*or equivalent*)
(not in order of importance)

Medium Priority

A Eritrea –**moved from low to medium**
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)