

Geminivirus strain demarcation and nomenclature

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Abstract Geminivirus taxonomy and nomenclature is growing in complexity with the number of genomic sequences deposited in sequence databases. Taxonomic and nomenclatural updates are published at regular intervals (Fauquet et al. in Arch Virol 145:1743–1761, 2000, Arch Virol 148:405–421, 2003). A system to standardize

virus names, and corresponding guidelines, has been proposed (Fauquet et al. in Arch Virol 145:1743–1761, 2000). This system is now followed by a large number of geminivirologists in the world, making geminivirus nomenclature more transparent and useful. In 2003, due to difficulties inherent in species identification, the ICTV *Geminiviridae* Study Group proposed new species demarcation criteria, the most important of which being an 89% nucleotide (nt) identity threshold between full-length DNA-A component nucleotide sequences for begomovirus species. This threshold has been utilised since with general satisfaction. More recently, an article has been published to clarify the terminology used to describe virus entities below the species level [5]. The present publication is proposing demarcation criteria and guidelines to classify and name geminiviruses below the species level. Using the Clustal V algorithm (DNASTar MegAlign software), the distribution of pairwise sequence comparisons, for pairs of sequences below the species taxonomic level, identified two peaks: one at 85–94% nt identity that is proposed to correspond to “strain” comparisons and one at 92–100% identity that corresponds to “variant” comparisons. Guidelines for descriptors for each of these levels are proposed to standardize nomenclature under the species level. In this publication we review the status of geminivirus species and strain demarcation as well as providing updated isolate descriptors for a total of 672 begomovirus isolates. As a consequence, we have revised the status of some virus isolates to classify them as “strains”, whereas several others previously classified as “strains” have been upgraded to “species”. In all other respects, the classification system has remained robust, and we therefore propose to continue using it. An updated list of all geminivirus isolates and a phylogenetic tree with one representative isolate per species are provided.

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Introduction

Geminiviruses are circular single-stranded DNA viruses with one or two components to their genomes. They are transmitted by insects and infect either monocots or dicots [10]. The names of geminiviruses have been standardised, and a set of rules to derive names for newly identified species were laid down several years ago [6]. In 2003, following guidelines established by the International Committee on Taxonomy of Viruses (ICTV) [11], we published a comprehensive list of species and isolates of geminiviruses [7]. One major development outlined at the time was the application of an arbitrary threshold value with which to demarcate distinct geminivirus species. This threshold was determined by analysing a large number of DNA-A sequences ($n = 217$) of members of the genus *Begomovirus*, from which it became clear that 89% nucleotide sequence identity represented an appropriate working value [4]. This allowed us to identify 102 distinct begomovirus species. This number increased to 147 by 2004. Since then, the number of complete DNA-A sequences has risen to 592, necessitating another review of the list of species in the context of the criteria established in 2003. This will provide the opportunity to update the list of species and isolate names and correct many of the errors present in the sequence database entries according to the established guidelines. In addition, we propose guidelines to incorporate strain and variant demarcation criteria and descriptors to the virus names so as to have a more precise identification of the rapidly increasing number of geminivirus sequences.

There is no formally accepted definition for any taxa below the species level, and no standardized approach has been established to deal with this issue. Certainly, the mandate of the ICTV does not include any consideration under the species level, and, hence, the decision has been left to the initiative of speciality groups like the *Geminiviridae* Study Group. With the exponential increase in DNA sequencing, and because biologists are encountering new isolates for which the biological properties are being determined and/or are of importance in breeding programs for disease resistance, establishing a geminivirus nomenclature system below the species level has become timely and essential. In order to classify viruses and to avoid further confusion, we published in 2005 a paper [5] describing the nomenclature used by virologists below the species level, and we proposed, for the time being, to restrict the number of categories to “strains” and “variants”. It is *de facto* accepted by the virologists that there is no homogeneity in the demarcation criteria, nomenclature and classification below the species level, and each specialty group is establishing an appropriate system for its respective family. However, newly proposed classification systems, such as that proposed herein for geminiviruses,

adds additional value to the science of virus taxonomy because it sets a useful precedent.

Molecular genomic diversity below the species level

For pairwise comparisons of the full-length sequences of the genomes (or DNA-A genomic components) of 672 geminivirus isolates (225, 456 comparisons), at least two peaks can be distinguished in the range of 85–100% identity (Fig. 1a). The application of an arbitrary demarcation value of approximately 93% in the matrix of comparisons discriminated two populations that we have called “strains” and “variants”. These populations were then plotted separately to illustrate a distribution of percentage identities, shown in Figs. 1b and c, respectively. The “strains” peak ranges from 85 to 96%, while the “variants” peak ranges from 92 to 100%. There is an overlap between these two categories, just as there is an overlap between the peaks of the species and “strains” categories. Nevertheless, in the pairwise comparison matrix, it is straightforward to demarcate these categories. The first peak includes all begomoviruses that are clearly distinguishable as strains within the species level and can often be associated with a specific phenotype, host range or geographical distribution, while the second peak includes variants for which no clear unifying genotypic or phenotypic features is apparent. There is also a “shoulder” at 99–100% which may be attributable to either random point mutations or PCR/sequencing errors.

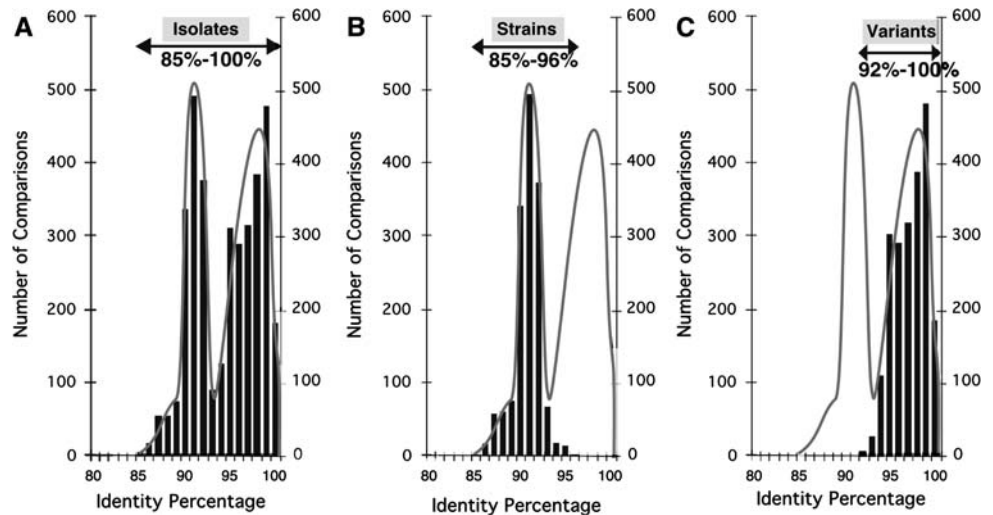
Virus strains

Although there is no official definition for a strain, the strain concept is widely used, and a *de facto* definition states “*strains are best represented by viruses belonging to the same species and having stable and heritable biological, serological, and/or molecular differences*”. This definition seems broad enough to accommodate many different situations, however the demarcation of strains and variants as per the threshold defined in the previous paragraph does not fit with some accepted strain descriptors for geminiviruses presently in use, such as:

East African cassava mosaic virus—Uganda2 Mild
East African cassava mosaic virus—Uganda2 Severe
Tomato golden mosaic virus—Common
Tomato golden mosaic virus—Yellow vein

The obvious reason for this discrepancy is that very subtle differences, possibly only a few nucleotides [1], can cause major phenotypic differences and thus fall outside the previously determined demarcation. A difference of 8% in pairwise comparisons, corresponding to the peak of the

Fig. 1 Distribution of pairwise sequence comparison (PASC) identity percentages between DNA-A sequences for 672 geminivirus isolates, under the species level; **a** for all isolates, **b** for members of the strain level, and **c** for variants



strain level, accounts for approximately 200 nts/comparison (100/geminivirus genome). This is much more than the number of mutations that is known to change an isolate phenotype from severe to mild [2, 3]. Chatterji et al. [2, 3] demonstrated that among the 127 nts that differed between the severe and mild DNA-A component of tomato leaf curl New Delhi virus (ToLCNDV), the phenotypic difference was in fact due to one mutation in the N-terminus of the Rep protein and a point mutation in one iteron in the common region. Although the visible phenotype (severe or mild) was *de facto* associated with these isolates, it is therefore understandable that it was a misnomer, and by extension we can appreciate that such phenotypic differences may not be associated with 8% difference in sequence.

Virus variants

The definition of a variant is “*something that differs slightly from the norm*”, but with respect to viruses it means a slightly different genome, symptom, or mode of transmission. The term was recently proposed for use with geminiviruses with very small differences, and this definition would therefore apply to isolates exhibiting phenotypic differences that could be explained by a few nucleotide differences. A difference of 2–3% in pairwise comparisons corresponds to 50–80 nucleotide differences (25–40 nucleotides per geminivirus genome).

Need for descriptors and classification guidelines under the species level

Due to the steadily increasing number of available geminivirus sequences, it is becoming increasingly

important to provide a rational system for assigning a newly characterized isolate to an existing strain, to a new strain, or to leave the isolate as a variant at the species level. Strain descriptors under the species level and guidelines to determine where a new isolate would best be classified are therefore needed. This can be achieved in two ways: first, by attempting to define quantitatively what constitutes a strain within a species, and second, by adopting descriptive identifiers to indicate a virus at the strain level. For the time being, variants could simply be defined by the absence of a descriptor and would correspond to all isolates that are not included in a specific strain. For strain designation, discriminating symptoms (mild, severe, yellow vein, stunting, etc.) and differential hosts (cowpea, soybean, mungbean, tobacco, tomato, etc.) are privileged descriptors and should be used more often when appropriate. When used at the strain level, host and symptom descriptors imply some level of host/symptom adaptation, as in the case of TYLCV isolates. In the case of unavailable distinguishing descriptors, letters A, B, C... would be used to designate the different strains.

Guidelines to demarcate strain designation

The matrix of the distances of pairwise sequence comparisons of all virus isolates can cluster them from the most closely related to the least related. The use of a percentage identity figure, as defined above, will allow grouping of virus isolates in strains (85–93%) and variants (94–100%) of strains or species. However, in some instances, due to extensive recombination, some isolates are highly related to several strains within a species, or even to isolates belonging to different species, making their classification

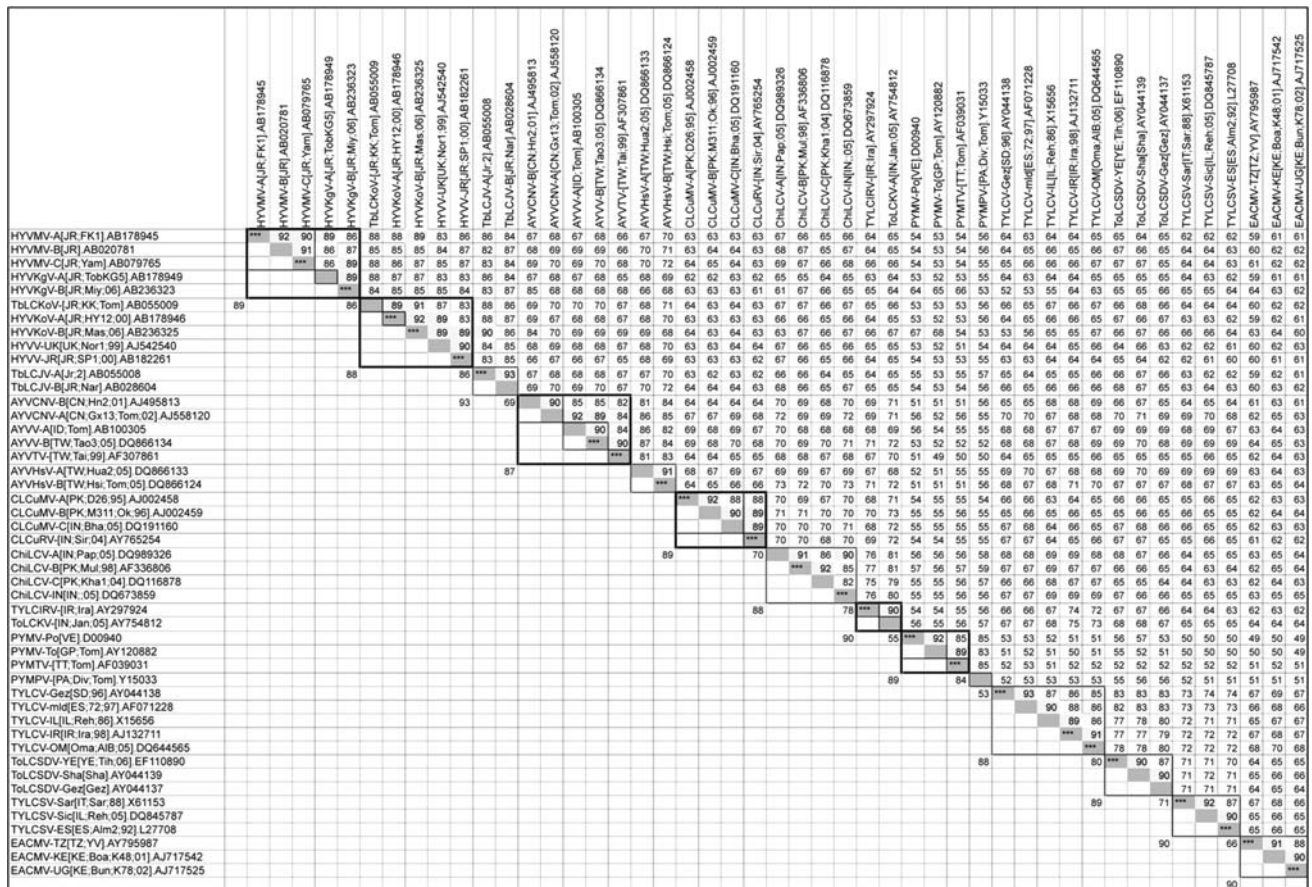
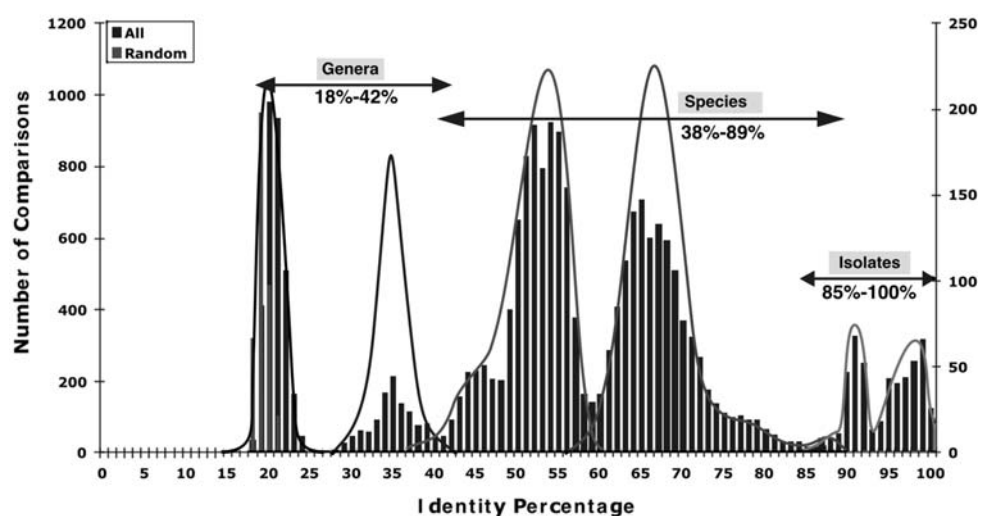


Fig. 2 Matrix of distances (% identity) of PASC identity percentages between DNA-A sequences of 47 geminivirus isolates belonging to 21 virus species. To avoid confusion with the new nomenclature now established, the old nomenclature has been used in this matrix and may not be the one finally chosen and listed in Table 1. The grey and

light grey cells identify variant, strain and species relationships, respectively. The thick cell borders represent proposed new species. At the lower left end side of the species boxes is indicated the intra-species pairwise percentage identity, while the inter-species pairwise percentage identity is indicated between two species boxes

Fig. 3 PASC identity percentages between DNA-A sequences for 672 geminivirus isolates. Genus, species and isolate levels are identified



contentious. We have investigated different methods of demarcation, and a quantitative evaluation of the relationship of a contentious isolate to all the isolates of a specific species seems the most appropriate method for resolving this classification dilemma.

Homogeneous classification of geminivirus isolates into strains and species

Of 252 isolates, representing 209 species, 102 cluster in more than one strain per species, but only 37 of those

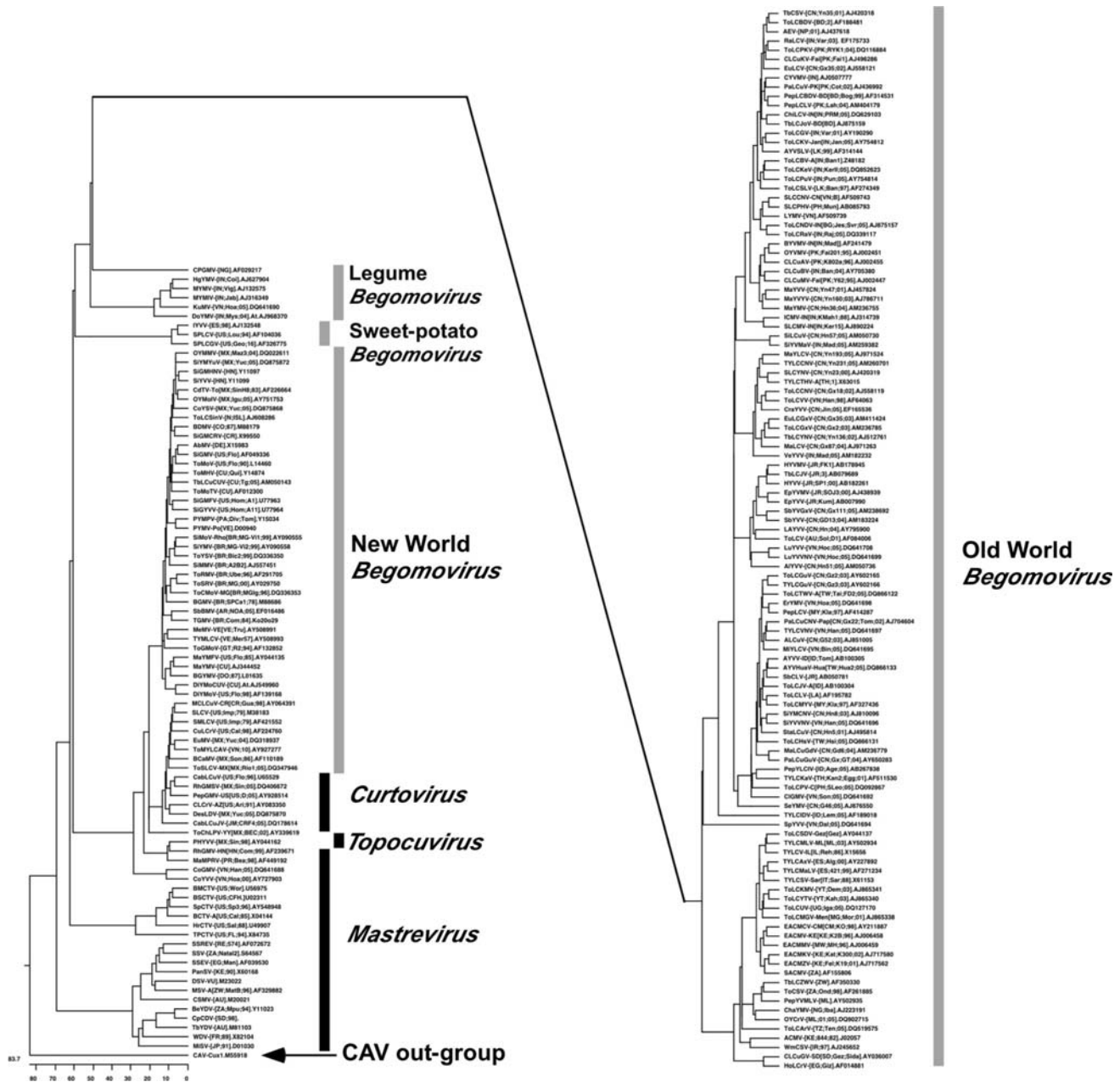


Fig. 4 Phylogenetic tree representing 200 geminivirus representative isolates of 200 species. Chicken anemia virus (CAV) has been used as an outgroup individual. The tree was calculated and designed with the software MegAlign of DNASTar (Lasergene) using the Clustal V algorithm. Virus names for the abbreviation in the tree can be found

in Table 1. The accession number used for each virus is listed after the virus abbreviation. For convenience, the tree has been truncated into two separate clusters. The genera in the family *Geminiviridae* are indicated. The genus *Begomovirus* has been separated into clusters, one each from the Old and New World, respectively

present some degree of heterogeneity at the species level worth considering in this paper. The other 65 isolates comply with the 89% rule, showing an intra-species pairwise nucleotide identity of 91%. The remaining 37 isolates, currently belonging to 17 species, can be divided into two categories. In the first category, 17 isolates, belonging to 5 species, have intra-species pairwise comparisons that are below the species threshold level. In the second category, 20 isolates, belonging to 14 species, have pairwise comparisons above the species threshold (Fig. 2). This heterogeneity reflects in part the history of geminivirus taxonomy and in part the difficulty in some instances to assign a virus isolate to the correct species, or the lack of precise guidelines for assigning an isolate to a specific species. This paper proposes to correct the heterogeneity of geminivirus isolates at the strain level by including in the same species a number of isolates previously belonging to different species (Figs. 3, 4).

In the first category of strains that have intra-species pairwise comparisons below the species level, it is clear that recombination between different isolates has led to higher levels of identity between them, constituting a set of viruses that is best kept together as a single species. The example for this situation is the TYLCV cluster, comprising five strains with pairwise percentages from 92 to 85% (Fig. 2).

The second category corresponds to viruses belonging to different species for which intermediates have been found or for which, with hindsight, anomalous decisions have been made over the years. A good example is the cluster including TbLCJV-[JR;3] and HYVKgV-[JR;TobKG5]. For these isolates the species threshold was set at 90%. At a 89% threshold, these five viruses would be classified as three species. Similarly, PYMTV, but not PYMPV, would be clustered with PYMV. Another example, where intermediates have been found, is the AYVCNV/AYVV cluster. It is now clear that this cluster resembles the TYLCV cluster and therefore should be treated similarly. The ToLCIRV/ToLCKV and CLCuMV/CLCuRV clusters are of the same category and should also be reconsidered as a single species (Fig. 2).

If the clusters of the second category are reclassified in single species, the intra-species pairwise percentages for the 21 clusters vary between 92 and 88%, and the inter-species pairwise percentages vary between 62 and 86% (Fig. 2).

On the basis of this proposal, the following viruses would be incorporated into a single species.

Ageratum yellow vein virus

AYVV-A[ID;Tom].AB100305	AYVV-A[ID;Tom].AB100305
AYVV-B[TW;Tao3;05]. DQ866134	AYVV-B[TW;Tao3;05]. DQ866134
AYVTV-[TW;Tai;99].AF307861	AYVV-C[TW;Tai;99]. AF307861
AYVCNV-A[CN;Gx68;03]. AJ849916	AYVV-D[CN;Gx68;03]. AJ849916
AYVCNV-B[CN;Hn2.19;01]. AJ564744	AYVV-E[CN;Hn2.19;01]. AJ564744

Cotton leaf curl Multan virus

CLCuMV-A[PK;Y62;95]. AJ002447	CLCuMV-A[PK;Y62;95]. AJ002447
CLCuMV-B[PK;Mul]. AJ496461	CLCuMV-B[PK;Mul]. AJ496461
CLCuMV-C[IN;Bha;05]. DQ191160	CLCuMV-C[IN;Bha;05]. DQ191160
CLCuRV-[IN;Abo;03]. AY795606	CLCuMV-D[IN;Abo;03]. AY795606

Honeysuckle yellow vein mosaic virus

HYVMV-A[JR;FK1]. AB178945	HYVMV-A[JR;FK1]. AB178945
HYVKgV-[JR;TobKG5]. AB178949	HYVMV-D[JR;TobKG5]. AB178949

Honeysuckle yellow vein virus

HYVV-UK[UK;Nor1;99]. AJ542540	HYVV-A[UK;Nor1;99]. AJ542540
HYVKoV-[JR;HY12;00]. AB178946	HYVV-C[JR;HY12;00]. AB178946
TbLCKoV-[JR;KK;Tom]. AB055009	HYVV-D[JR;KK;Tom]. AB055009

Potato yellow mosaic virus

PYMV-Po[VE].D00940	PYMV-Po[VE].D00940
PYMV-To[GP;Tom].AY120882	PYMV-To[GP;Tom].AY120882
PYMTV-[TT;Tom].AF039031	PYMV-TT[TT;Tom].AF039031

Tomato leaf curl Karnataka virus

ToLCKV-A[IN;Jan;05].AY754812	ToLCKV-A[IN;Jan;05]. AY754812
ToLCKV-B[IN;Ban;93].U38239	ToLCKV-B[IN;Ban;93].U38239
ToLCIRV-[IR;Ira].AY297924	ToLCKV-C[IR;Ira].AY297924

Guidelines for the classification of geminivirus isolates in variants, strains and species

In order to classify all geminivirus isolates in a similar manner, and therefore obtain a homogeneous classification, the following guidelines are proposed:

1. Compare a new geminivirus isolate sequence to all known sequences representative of species;

- if the pairwise sequence comparison analysis <88%, it belongs to a new species.
 - if pairwise sequence comparison analysis =88–89%, it belongs tentatively to the closest species.
 - if pairwise sequence comparison analysis >89%, it belongs definitively to that species.
2. Compare a new geminivirus isolate sequence to all known sequences representative of strains and variants in the identified species;
- if pairwise sequence comparison analysis <93% to all known members, it is a member of a new strain in that species,
 - if pairwise sequence comparison analysis > 94% to an existing isolate, it is a variant of that strain in that species.

The software used for the pairwise sequence comparison analysis is the Clustal V algorithm and a subset of species representative sequences will be available on line at <http://www.danforthcenter.org/iltab/geminivirus>.

Nomenclature of virus isolate descriptors

In addition to the descriptor information becoming part of the virus name, it has been requested of GenBank to systematically request from authors a minimum of information with the deposited sequence, including the date and exact GPS location of the site from where the isolate was obtained. Although this has not been implemented yet, there are good reasons to believe that it will be very soon, as this information is increasingly important for epidemiological and evolutionary studies. It might even be possible to retrieve such information for the hundreds of isolates already recorded.

The *Geminiviridae* Study Group previously accepted that the first isolate of a species to be described did not require a distinguishing descriptor (for example TYLCV, TYLCSV, ToLCV) and did not always include this information in the species list, primarily to provide a concise name. However, because of the perceived need for distinguishing and informative descriptors, it is advisable to reconsider this decision and add an appropriate descriptor in all cases.

Table 1 Updated list of geminivirus species and isolate names with strain and variant descriptors

FAMILY	GEMINIVIRIDAE	
TAXONOMIC STRUCTURE OF THE FAMILY		
<i>Family</i>	<i>Geminiviridae</i>	
<i>Genus</i>	<i>Mastrevirus</i>	
<i>Genus</i>	<i>Curtovirus</i>	
<i>Genus</i>	<i>Topocuvirus</i>	
<i>Genus</i>	<i>Begomovirus</i>	
<i>Genus</i>	<i>Mastrevirus</i>	
<i>Type Species</i>	<i>Maize streak virus</i>	
LIST OF SPECIES DEMARCATION CRITERIA IN THE GENUS		
The following criteria should be used as a guideline to establish taxonomic status:		
1. Nucleotide sequence identity. Full-length nt sequence identity <75% is generally indicative of a distinct species. However, decisions based on nt sequence comparisons, particularly when approaching this value, must also take into account the biological properties of the virus.		
2. <i>Trans</i> -replication of genomic components. The inability of Rep protein to <i>trans</i> -replicate a genomic component suggests a distinct species.		
3. Coat protein characteristics. Serological differences may be indicative of a distinct species.		
4. Different vector species.		
5. Natural host range and symptom phenotype. These characteristics may relate to a particular species, but their commonest use will be to distinguish strains.		
LIST OF SPECIES IN THE GENUS		
Species names are in italic script; isolate names and synonyms are in black roman script; tentative species names are in black roman script. Sequence accession numbers and assigned abbreviations are also listed.		
SPECIES IN THE GENUS		
<i>Bean yellow dwarf virus</i>		
Bean yellow dwarf virus- [South Africa:Mpumalanga:1994]	Y11023	BeYDV-[ZA:Mpu:94]
<i>Chickpea chlorotic dwarf virus</i>		
Chickpea chlorotic dwarf virus-[Iran]	?	CpCDV-[IR]
<i>Chloris striate mosaic virus</i>		
Chloris striate mosaic virus-[Australia]	M20021	CSMV-[AU]

Table 1 continued

<i>Digitaria streak virus</i>		
Digitaria streak virus-[Vanuatu]	M23022	DSV-[VU]
<i>Maize streak virus</i>		
Maize streak virus, A [Kenya:Amagoro:1998]	AF329878	MSV-A[KE:Ama:98]
Maize streak virus, A [Kenya:Gathuke-ini:1998]	AF329879	MSV-A[KE:Gat:98]
Maize streak virus, A [Kenya:Km]	AF395891	MSV-A[KE:Km]
Maize streak virus, A [Kenya:Mt Kenya:1997]	AF329885	MSV-A[KE:MtKA:97]
Maize streak virus, A [Kenya:Sagana:1998]	AF329880	MSV-A[KE:Sag:98]
Maize streak virus, A [Kenya]	X01089	MSV-A[KE]
Maize streak virus, A [Nigeria1]	X01633	MSV-A[NG1]
Maize streak virus, A [RE:N2AR2:1993]	AJ224504	MSV-A[RE:N2AR2:93]
Maize streak virus, A [RE:N2AR3:1993]	AJ224505	MSV-A[RE:N2AR3:93]
Maize streak virus, A [RE:N2AR4:1993]	AJ224506	MSV-A[RE:N2AR4:93]
Maize streak virus, A [RE:N2AR5:1993]	AJ224507	MSV-A[RE:N2AR5:93]
Maize streak virus, A [RE:N2AR6:1993]	AJ224508	MSV-A[RE:N2AR6:93]
Maize streak virus, A [RE:N2AR8:1993]	AJ225006	MSV-A[RE:N2AR8:93]
Maize streak virus, A [RE:SP1R10:1991]	AJ225007	MSV-A[RE:SP1R10:91]
Maize streak virus, A [RE:SP2R11:1995]	AJ225009	MSV-A[RE:SP2R11:95]
Maize streak virus, A [RE:SP2R12:1995]	AJ225010	MSV-A[RE:SP2R12:95]
Maize streak virus, A [RE:SP2R13:1995]	AJ225011	MSV-A[RE:SP2R13:95]
Maize streak virus, A [RE:SP2R7:1995]	AJ225008	MSV-A[RE:SP2R7:95]
Maize streak virus, A [South Africa:Komatipoort:1989]	AF003952	MSV-A[ZA:Kom:89]
Maize streak virus, A [South Africa:MakatiniD:1998]	AF329884	MSV-A[ZA:MakD:98]
Maize streak virus, A [South Africa:Vaalhart Maize:1993]	AF239961	MSV-A[ZA:VM:93]
Maize streak virus, A [South Africa]	Y00514	MSV-A[ZA]
Maize streak virus, A [Uganda:Kab48:2005]	EF015782	MSV-A[UG:Kab48:05]
Maize streak virus, A [Uganda:Kas42:2005]	EF015780	MSV-A[UG:Kas42:05]
Maize streak virus, A [Uganda:Kas43:2005]	EF015779	MSV-A[UG:Kas43:05]
Maize streak virus, A [Uganda:Mba27:2005]	EF015781	MSV-A[UG:Mba27:05]
Maize streak virus, A [Uganda:Wak56:2005]	EF015778	MSV-A[UG:Wak56:05]
Maize streak virus, A [Zimbabwe:MatabelelandA:1994]	AF329881	MSV-A[ZW:MatA:94]
Maize streak virus, A [Zimbabwe:MatabelelandB:1996]	AF329882	MSV-A[ZW:MatB:96]
Maize streak virus, A [Zimbabwe:MatabelelandC:1998]	AF329883	MSV-A[ZW:MatC:98]
Maize streak virus, B [Kenya:Jamaica:1999]	AF329887	MSV-B[KE:Jam:99]
Maize streak virus, B [Kenya:Mombasa:1998]	AF329886	MSV-B[KE:Mom:98]
Maize streak virus, B [South Africa:Triticum:1991]	AF239962	MSV-B[ZA:Tas:91]
Maize streak virus, B [South Africa:Vaalhart Wheat:1993]	AF239960	MSV-B[ZA:VW:93]
Maize streak virus, C [South Africa:Setaria:1988]	AF007881	MSV-C[ZA:Set:88]
Maize streak virus, D [South Africa:Rawsonville:1998]	AF329889	MSV-D[ZA:Raw:98]
Maize streak virus, E [South Africa:Pat:1999]	AF329888	MSV-E[ZA:Pat:99]
<i>Miscanthus streak virus</i>		
Miscanthus streak virus-[Japan:1991]	D01030	MiSV-[JP91]
Miscanthus streak virus-[Japan:1996]	E02258	MiSV-[JP96]
Miscanthus streak virus-[Japan:1998]	D00800	MiSV-[JP98]
<i>Panicum streak virus</i>		
Panicum streak virus-Karino [South Africa:1989]	L39638	PanSV-Kar[ZA:89]
Panicum streak virus-Kenya [Kenya:1990]	X60168	PanSV-[KE:90]

Table 1 continued

<i>Sugarcane streak virus</i>		
Sugarcane streak virus-[South Africa:Natal]	M82918, S64567	SSV-[ZA:Nat]
<i>Sugarcane streak Egypt virus</i>		
Sugarcane streak Egypt virus-[Egypt:Aswan]	AF039528	SSEV-[EG:Asw]
Sugarcane streak Egypt virus-[Egypt:Beni-Suef]	AF039529	SSEV-[EG:Ben]
Sugarcane streak Egypt virus-[Egypt:Giza]	AF037752	SSEV-[EG:Giza]
Sugarcane streak Egypt virus-[Egypt:Mansoura]	AF039530	SSEV-[EG:Man]
Sugarcane streak Egypt virus-[Egypt:Naga Hammady]	AF239159	SSEV-[EG:Naga]
<i>Sugarcane streak Reunion virus</i>		
Sugarcane streak Reunion virus-[Reunion:R574]	AF072672	SSREV-[RE:574]
<i>Tobacco yellow dwarf virus</i>		
Tobacco yellow dwarf virus-[Australia]	M81103	TbYDV-[AU]
<i>Wheat dwarf virus</i>		
Wheat dwarf virus-Wheat [China:Taiyuan:05]	DQ868525	WDV-Whe[CN:Tai:05]
Wheat dwarf virus-Wheat [France:1989]	X82104	WDV-Whe[FR:89]
Wheat dwarf virus-Wheat [Hungary:B:2005]	AM040732	WDV-Whe[HU:B:05]
Wheat dwarf virus-Wheat [Hungary:F:2005]	AM040733	WDV-Whe[HU:F:05]
Wheat dwarf virus-Wheat [Sweden:Enköping1]	AJ311031	WDV-Whe[SE:Enk1]
Wheat dwarf virus-Wheat [Sweden]	X02869	WDV-Whe[SE]
Wheat dwarf virus-Barley [Turkey:Barley]	AJ783960	WDV-Bar[TR:Bar]
UNASSIGNED ISOLATES IN THE GENUS		
<i>Bajra streak virus</i>		BaSV
<i>Bromus striate mosaic virus</i>		BrSMV
<i>Digitaria striate mosaic virus</i>		DiSMV
<i>Millet streak virus</i>		MISV
<i>Paspalum striate mosaic virus</i>		PSMV
GENUS		
CURTOVIRUS		
<i>Type Species</i>		
<i>Beet curly top virus</i>		
LIST OF SPECIES DEMARCATION CRITERIA IN THE GENUS		
The following criteria should be used as a guideline to establish taxonomic status:		
1. Nucleotide sequence identity. Full-length nt sequence identity <89% is generally indicative of a distinct species. However, decisions based on nt sequence comparisons, particularly when approaching this value, must also take into account the biological properties.		
2. <i>Trans</i> -replication of genomic components. The inability of Rep protein to <i>trans</i> -replicate a genomic component suggests a distinct species.		
3. CP characteristics. Serological differences may be indicative of a distinct species although the CP is highly conserved, suggesting that this criterion may be of limited use.		
4. Natural host range and symptom phenotype. These characteristics may relate to a particular species, but their commonest use will be to distinguish strains.		
LIST OF SPECIES IN THE GENUS		
Species names are in italic script; isolate names and synonyms are in black roman script; tentative species names are in black roman script. Sequence accession numbers and assigned abbreviations are also listed.		
SPECIES IN THE GENUS		
<i>Beet curly top virus</i>		
Beet curly top virus-A [United States of America:California:1985]	X04144	BCTV-A[US:Cal:85]
Beet curly top virus-B [United States of America:Logan:1976]	AF379637	BCTV-B[US:Log:76]
<i>Beet mild curly top virus</i>		
Beet mild curly top virus-[United States of America:Worland]	U56975	BMCTV-[US:Wor]
Beet mild curly top virus-[United States of America:Worland 4]	AY134867	BMCTV-[US:Wor4]

Table 1 continued***Beet severe curly top virus***

Beet severe curly top virus-[United States of America:Cfh]	U02311	BSCTV-[US:Cfh]
Beet severe curly top virus-[Iran:1986]	X97203	BSCTV-[IR:86]

Horseradish curly top virus

Horseradish curly top virus-[United States of America:Salinas:1988]	U49907	HrCTV-[US:Sal:88]
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Spinach curly top virus

Spinach curly top virus-[United States of America:Spinach 3:1996]	AY548948	SpCTV-[US:Sp3:96]
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UNASSIGNED ISOLATES IN THE GENUS

Tomato leaf roll virus

TLRV

GENUS

TOPOCUVIRUS

Type Species***Tomato pseudo-curly top virus***

LIST OF SPECIES DEMARCATION CRITERIA IN THE GENUS

Currently, there is only one species in this genus. Criteria to establish taxonomic status are identical to those for the genus *Curtovirus*.

LIST OF SPECIES IN THE GENUS

Species names are in italic script; isolate names and synonyms are in black roman script; tentative species names are in black roman script. Sequence accession numbers and assigned abbreviations are also listed.

SPECIES IN THE GENUS

Tomato pseudo-curly top virus

Tomato pseudo-curly top virus-[United States of America:Florida:1994]	X84735	TPCTV-[US:FL:94]
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UNASSIGNED ISOLATES IN THE GENUS

None reported

GENUS

BEGOMOVIRUS

Type Species***Bean golden yellow mosaic virus***

LIST OF SPECIES DEMARCATION CRITERIA IN THE GENUS

The following criteria should be used as a guideline to establish taxonomic status:

1. Number of genomic components. Presence or absence of a DNA B component
2. Organization of the genome. Presence or absence of ORF AV2.
3. Nucleotide sequence identity. Because of the growing number of recognized species, derivation of the complete nt sequence will be necessary to distinguish species. Nucleotide sequence identity <89% is generally indicative of a distinct species. However, decisions based on nt sequence comparisons, particularly when approaching this value, must also take into account the biological properties of the virus. The taxonomic status of a recombinant will depend on relatedness to the parental viruses, the frequency and extent of recombination events, and its biological properties compared with the parental viruses. Information concerning the diversity of related recombinants may be helpful to determine status.
4. *Trans*-replication of genomic components. The inability of Rep protein to *trans*-replicate a genomic component suggests a distinct species. However, when considering this criterion, it should be kept in mind that small changes in the Rep binding site of otherwise identical viruses might prevent functional interaction, and recombination involving a small part of the genome may confer replication competence on a distinct species.
5. Production of viable pseudorecombinants. Account should be taken of the fitness of the pseudorecombinant in the natural host(s) of the parental viruses. It should be ensured that pseudorecombinant viability is not the result of inter-component recombination.
6. Capsid protein characteristics. Amino acid sequence identity < 90% and substantial serological differences may be indicative of a distinct species in the first instance, but derivation of the complete sequence will be necessary to confirm taxonomic status.
7. Natural host range and symptom phenotype. These characteristics may relate to a particular species, but their commonest use will be to distinguish strains.

LIST OF SPECIES IN THE GENUS

Species names are in italic script; isolate names and synonyms are in black roman script; tentative species names are in black roman script. Sequence accession numbers and assigned abbreviations are also listed.

SPECIES IN THE GENUS

Abutilon mosaic virus

Abutilon mosaic virus-[United States of America:Hawaii]	U51137	U51138	AbMV-[US:Haw]
Abutilon mosaic virus-[Germany]	X15983	X15984	AbMV-[DE]

Table 1 continued

<i>African cassava mosaic virus</i>			
African cassava mosaic virus-[Cameroon:1998]	AF112352	AF112353	ACMV-[CM:98]
African cassava mosaic virus-[Cameroon:DO2:1998]	AF366902		ACMV-[CM:DO2:98]
African cassava mosaic virus-[Cameroon:DO3:1998]	AY211885		ACMV-[CM:DO3:98]
African cassava mosaic virus-[Cameroon:KT:1998]		AY211886	ACMV-[CM:KT:98]
African cassava mosaic virus-[Cameroon:Mg:1998]	AY211884		ACMV-[CM:Mg:98]
African cassava mosaic virus-[Côte d'Ivoire:1999]	AF259894	AF259895	ACMV-[CI:99]
African cassava mosaic virus-[Kenya:844:1982]	J02057	J02058	ACMV-[KE:844:82]
African cassava mosaic virus-[Nigeria:Ogoroco:1990]	AJ427910	AJ427911	ACMV-[NG:Ogo:90]
African cassava mosaic virus-[Nigeria]	X17095	X17095	ACMV-[NG]
African cassava mosaic virus-[Tanzania:2001]	AY795982		ACMV-[TZ:01]
African cassava mosaic virus-[Uganda:Mild:1997]	AF126800	AF126801	ACMV-[UG:Mld:97]
African cassava mosaic virus-[Uganda:Severe:1997]	AF126802	AF126803	ACMV-[UG:Svr:97]
<i>Ageratum enation virus</i>			
Ageratum enation virus-[Nepal:2001]	AJ437618		AEV-[NP:01]
Ageratum enation virus-[Pakistan:Lahore:2004]	AM261836		AEV-[PK:Lah:04]
<i>Ageratum leaf curl virus</i>			
Ageratum leaf curl virus-[China:Guangxi 52:2003]	AJ851005		ALCuV-[CN:Gx52:03]
<i>Ageratum yellow vein Hualian virus</i>			
Ageratum yellow vein Hualian virus-Hsinchu[Taiwan:Hsinchu:Tom:2003]	DQ866124		AYVHuV-Hsi[TW:Hsi:Tom:03]
Ageratum yellow vein Hualian virus-Hualian[Taiwan:Hualian2:2000]	DQ866133		AYVHuV-Hua[TW:Hua2:00]
Ageratum yellow vein Hualian virus-Hualian[Taiwan:Hualian4:2000]	DQ866132		AYVHuV-Hua[TW:Hua4:00]
<i>Ageratum yellow vein Sri Lanka virus</i>			
Ageratum yellow vein Sri Lanka virus-[Sri Lanka:1999]	AF314144		AYVSLV-[LK:99]
<i>Ageratum yellow vein virus</i>			
Ageratum yellow vein virus-Guangxi [China:Guangxi 13:Tomato:2002]	AJ558120		AYVV-Gx [CN:Gx13:Tom:02]
Ageratum yellow vein virus-Guangxi [China:Guangxi 68:2003]	AJ849916		AYVV-Gx [CN:Gx68:03]
Ageratum yellow vein virus-Hainan [China:Hainan1.19:2001]	AJ564744		AYVV-Hn [CN:Hn2.19:01]
Ageratum yellow vein virus-Hainan [China:Hainan2:2001]	AJ495813		AYVV-Hn [CN:Hn2:01]
Ageratum yellow vein virus-Indonesia [Indonesia:Tomato]	AB100305		AYVV-ID[ID:Tom]
Ageratum yellow vein virus-Singapore [Singapore:1992]	X74516		AYVV-SG[SG:92]
Ageratum yellow vein virus-Singapore [Taiwan:Taoyuan:2005]	DQ866134		AYVV-SG[TW:Tao:05]
Ageratum yellow vein virus-Taiwan [Taiwan:Ping Dong]	AF327902		AYVV-TW[TW:PD]
Ageratum yellow vein virus-Taiwan [Taiwan:Tainan:1999]	AF307861		AYVV-TW[TW:Tai:99]
<i>Alternanthera yellow vein virus</i>			
Alternanthera yellow vein virus-[China:Guangxi 38:Ludwigia:2003]	AJ965540		AIYVV-[CN:Gx38:Lud:03]
Alternanthera yellow vein virus-[China:Hainan 51:2004]	AM050736		AIYVV-[CN:Hn51:04]
Alternanthera yellow vein virus-[Vietnam:Hanoi:2005]	DQ641704		AIYVV-[VN:Hanoi:05]
Alternanthera yellow vein virus-[Vietnam:Hue:2005]	DQ641703		AIYVV-[VN:Hue:05]
<i>Bean calico mosaic virus</i>			
Bean calico mosaic virus-[Mexico:Sonora:1986]	AF110189	AF110190	BCaMV-[MX:Son:86]
<i>Bean dwarf mosaic virus</i>			
Bean dwarf mosaic virus-[Colombia:1987]	M88179	M88180	BDMV-[CO:87]

Table 1 continued

<i>Bean golden mosaic virus</i>			
Bean golden mosaic virus-[Brazil:Campinas1:1978]	M88686	M88687	BGMV-[BR:Cam1:78]
<i>Bean golden yellow mosaic virus</i>			
Bean golden yellow mosaic virus-[Cuba]	AJ544531		BGYMV-[CU]
Bean golden yellow mosaic virus-[Dominican Republic:1987]	L01635	L01636	BGYMV-[DO:87]
Bean golden yellow mosaic virus-[Dominican Republic:BG]	D00201	D00200	BGYMV-[DO:BG]
Bean golden yellow mosaic virus-[Guatemala:1987]	M91604	M91605	BGYMV-[GT:87]
Bean golden yellow mosaic virus-[Mexico:Chiapas]	AF173555	AF173556	BGYMV-[MX:Chi]
Bean golden yellow mosaic virus-[Puerto Rico]	M10070	M10080	BGYMV-[PR]
Bean golden yellow mosaic virus-[United States of America:Homestead:2005]	DQ119824	DQ119825	BGYMV-[US:Hom:05]
<i>Bhendi yellow vein mosaic virus</i>			
Bhendi yellow vein mosaic virus-India [India:Madurai]	AF241479		BYVMV-IN[IN:Mad]
Bhendi yellow vein mosaic virus-Pakistan [Pakistan:Multan301:1996]	AJ002453		BYVMV-PK[PK:M301:96]
<i>Cabbage leaf curl Jamaica virus</i>			
Cabbage leaf curl Jamaica virus-[Jamaica:CUC3:2005]	DQ178608	DQ178609	CabLCuJV-[JM:CUC3:05]
Cabbage leaf curl Jamaica virus-[Jamaica:CUC32:2005]	DQ178610	DQ178611	CabLCuJV-[JM:CUC32:05]
Cabbage leaf curl Jamaica virus-[Jamaica:Douglas Castle:2005]	DQ178614	DQ178613	CabLCuJV-[JM:DC:05]
<i>Cabbage leaf curl virus</i>			
Cabbage leaf curl virus-[Jamaica:Douglas Castle:2005]	DQ178612		CabLCuV-[JM:DC:05]
Cabbage leaf curl virus-[United States of America:Florida:1996]	U65529	U65530	CabLCuV-[US:Flo:96]
<i>Chayote yellow mosaic virus</i>			
Chayote yellow mosaic virus-[Nigeria:Ibadan]	AJ223191		ChaYMV-[NG:Iba]
<i>Chilli leaf curl virus</i>			
Chilli leaf curl virus-India [India::05]	DQ673859		ChiLCV-IN[IN::05]
Chilli leaf curl virus-India [India:Papaya:2005]	DQ989326		ChiLCV-IN[IN:Pap:05]
Chilli leaf curl virus-India [India:PRM:Tomato:2005]	DQ629103		ChiLCV-IN[IN:PRM:Tom:05]
Chilli leaf curl virus-India [India:Varanasi:2006]	EF190217		ChiLCV-IN[IN:Var:06]
Chilli leaf curl virus-Khanewal [Pakistan:Khanewal 1:2004]	DQ116878		ChiLCV-Kha[PK:Kha1:05]
Chilli leaf curl virus-Pakistan [Pakistan:Multan:1998]	AF336806		ChiLCV-PK[PK:Mul:98]
<i>Chino del tomate virus</i>			
Chino del tomate virus-Soybean [Mexico:Sinaloa:2005]	DQ347945		CdTV-Sb[MX:Sin:05]
Chino del tomate virus-Tomato [Mexico:Cinvestav]		U57458	CdTV-To[MX:Cin]
Chino del tomate virus-Tomato [Mexico:RK:2005]	DQ885456		CdTV-To[MX:RK:05]
Chino del tomate virus-Tomato [Mexico:Sinaloa B52:1983]		AF226666	CdTV-To[MX:SinB52:83]
Chino del tomate virus-Tomato [Mexico:Sinaloa H6:1983]	AF226665		CdTV-To[MX:SinH6:83]
Chino del tomate virus-Tomato [Mexico:Sinaloa H8:1983]	AF226664		CdTV-To[MX:SinH8:83]
Chino del tomate virus-Tomato [Mexico:Sinaloa IC:1983]	AF101476	AF101478	CdTV-To[MX:SinIC:83]
Chino del tomate virus-Tomato [Mexico:Sinaloa:1983]		AF007823	CdTV-To[MX:Sin:83]

Table 1 continued

<i>Clerodendron golden mosaic virus</i>			
Clerodendron golden mosaic virus-[Vietnam:Sonla:2005]	DQ641692	DQ641693	CLGMV-[VN:Son:05]
<i>Corchorus golden mosaic virus</i>			
Corchorus golden mosaic virus-[Vietnam:Hanoi:2005]	DQ641688	DQ641689	CoGMV-[VN:Han:05]
<i>Corchorus yellow spot virus</i>			
Corchorus yellow spot virus-[Mexico:Yucatan:2005]	DQ875868	DQ875869	CoYSV-[MX:Yuc:05]
<i>Corchorus yellow vein virus</i>			
Corchorus yellow vein virus-[Vietnam:Hoa Binh:2000]	AY727903	AY727904	CoYVV-[VN:Hoa:00]
<i>Cotton leaf crumple virus</i>			
Cotton leaf crumple virus-Arizona [Mexico:Sonora:1991]	AF480940	AF480941	CLCrV-AZ[MX:Son:91]
Cotton leaf crumple virus-Arizona [United States of America:Arizona:1991]	AY083350		CLCrV-AZ[US:Ari:91]
Cotton leaf crumple virus-Arizona [United States of America:California:1991]	AY742220	AY742221	CLCrV-AZ[US:Cal:91]
Cotton leaf crumple virus-Texas [United States of America:Texas:1991]	AY083351		CLCrV-TX[US:Tex:91]
<i>Cotton leaf curl Alabad virus</i>			
Cotton leaf curl Alabad virus-[Pakistan:Alabad 804a:1996]	AJ002452		CLCuAV-[PK:A804a:96]
Cotton leaf curl Alabad virus-[Pakistan:Kohiwal 802a:1996]	AJ002455		CLCuAV-[PK:K802a:96]
<i>Cotton leaf curl Bangalore virus</i>			
Cotton leaf curl Bangalore virus-[India:Bangalore:2004]	AY705380		CLCuBV-[IN:Ban:04]
<i>Cotton leaf curl Gezira virus</i>			
Cotton leaf curl Gezira virus-Egypt [Egypt:Aswan:Okra]	AF155064		CLCuGV-EG[EG:AswOk]
Cotton leaf curl Gezira virus-Egypt [Egypt:Cairo:Okra]	AY036010		CLCuGV-EG[EG:Cai:Ok]
Cotton leaf curl Gezira virus-Hollyhock[Egypt:Cairo:Hollyhock]	AJ542539		CLCuGV-Hol[EG:Cai:Hol]
Cotton leaf curl Gezira virus-Sudan [Sudan:Gezira:Okra]	AY036006		CLCuGV-SD[SD:Gez:Ok]
Cotton leaf curl Gezira virus-Sudan [Sudan:Gezira:Sida]	AY036007		CLCuGV-SD[SD:Gez:Si]
Cotton leaf curl Gezira virus-Sudan [Sudan:Gezira]	AF260241		CLCuGV-SD[SD:Gez]
Cotton leaf curl Gezira virus-Sudan [Sudan:Shambat:Okra]	AY036008		CLCuGV-SD[SD:Sha:Ok]
<i>Cotton leaf curl Kokhran virus</i>			
Cotton leaf curl Kokhran virus-Faisalabad [Pakistan:Faisalabad1]	AJ496286		CLCuKV-Fai[PK:Fai1]
Cotton leaf curl Kokhran virus-Faisalabad [Pakistan:Kokhran 72b:1995]	AJ002448		CLCuKV-Fai[PK:K72b:95]
Cotton leaf curl Kokhran virus-Manisal [India:Dabawali]	AY456683		CLCuKV-Man[IN:Dab]
Cotton leaf curl Kokhran virus-Manisal [Pakistan:Manisal 806b:1996]	AJ002449		CLCuKV-Man[PK:M806b:96]
<i>Cotton leaf curl Multan virus</i>			
Cotton leaf curl Multan virus-Bhatinda [India:Bhatinda]	DQ191160		CLCuMV-Bha[IN:Bha]
Cotton leaf curl Multan virus-Faisalabad [Pakistan:Dera Ghazi Khan 26:1995]	AJ002458		CLCuMV-Fai[PK:D26:95]
Cotton leaf curl Multan virus-Faisalabad [Pakistan:Faisalabad 1]	X98995		CLCuMV-Fai[PK:Fai1]
Cotton leaf curl Multan virus-Faisalabad [Pakistan:Faisalabad 2]	AJ496287		CLCuMV-Fai[PK:Fai2]

Table 1 continued

Cotton leaf curl Multan virus-Faisalabad [Pakistan:Yazman 62:1995]	AJ002447		CLCuMV-Fai[PK:Y62:95]
Cotton leaf curl Multan virus-Hisar [India:Hisar:1999]	AY765253		CLCuMV-His[IN:His:99]
Cotton leaf curl Multan virus-Hisar [India:Ludhiana:1999]	AY765257		CLCuMV-His[IN:Lud:99]
Cotton leaf curl Multan virus-Hisar [India:New Delhi:1999]	AY765256		CLCuMV-His[IN:ND:99]
Cotton leaf curl Multan virus-Hisar [Pakistan:Faisalabad 3]	AJ132430		CLCuMV-His[PK:Fai3]
Cotton leaf curl Multan virus-Hisar [Pakistan:Multan 311:Okra:1996]	AJ002459		CLCuMV-His[PK:M311:Ok:96]
Cotton leaf curl Multan virus-Hisar [Pakistan:Multan]	AJ496461		CLCuMV-His[PK:Mul]
Cotton leaf curl Multan virus-Rajasthan [India:Abohar:2003]	AY795606		CLCuMV-Raj[IN:Abo:03]
Cotton leaf curl Multan virus-Rajasthan [India:Hisar:2003]	AY795607		CLCuMV-Raj[IN:His:03]
Cotton leaf curl Multan virus-Rajasthan [India:New Delhi2:2003]	AY795605		CLCuMV-Raj[IN:ND2:03]
Cotton leaf curl Multan virus-Rajasthan [India:Sirsa:1999]	AY765254		CLCuMV-Raj[IN:Sir:99]
Cotton leaf curl Multan virus-Rajasthan [India:Sriganganagar:1994]	AF363011		CLCuMV-Raj[IN:Sri:94]
<i>Cowpea golden mosaic virus</i>			
Cowpea golden mosaic virus-[Nigeria:Nsukka:1990]	AF029217		CPGMV-[NG:Nsu:90]
<i>Crassocephalum yellow vein virus</i>			
Crassocephalum yellow vein virus-[China;Jinhong;2005]	EF165536		CraYVV-[CN:Jin:05]
<i>Croton yellow vein mosaic virus</i>			
Croton yellow vein mosaic virus-[India]	AJ507777		CYVMV-[IN]
<i>Cucurbit leaf crumple virus</i>			
Cucurbit leaf crumple virus-[United States of America:Arizona:1991]	AF256200	AF327559	CuLCrV-[US:Ari:91]
Cucurbit leaf crumple virus-[United States of America:California:1998]	AF224760	AF224761	CuLCrV-[US:Cal:98]
<i>Desmodium leaf distortion virus</i>			
Desmodium leaf distortion virus-[Mexico:Yucatan:2005]	DQ875870	DQ875871	DesLDV-[MX:Yuc:05]
<i>Dicliptera yellow mottle Cuba virus</i>			
Dicliptera yellow mottle Cuba virus-[Cuba]	AJ549960		DiYMoCuV-[CU]
<i>Dicliptera yellow mottle virus</i>			
Dicliptera yellow mottle virus-[United States of America:Florida:1998]	AF139168	AF170101	DiYMoV-[US:Flo:98]
<i>Dolichos yellow mosaic virus</i>			
Dolichos yellow mosaic virus-[Bangladesh:Gazipur]	AY271891		DoYMV-[BD:Gaz]
Dolichos yellow mosaic virus-[India:Bangalore:2004]	AM157412		DoYMV-[IN:Ban:04]
Dolichos yellow mosaic virus-[India:Bangalore2:2004]	AM157413		DoYMV-[IN:Ban2:04]
Dolichos yellow mosaic virus-[India:Mysore;2004]	AJ968370		DoYMV-[IN:Mys;04]
Dolichos yellow mosaic virus-[India:Mysore]	AJ875159		DoYMV-[IN:Mys]
Dolichos yellow mosaic virus-[India:New Delhi:2000]	AY309241		DoYMV-[IN:ND:00]
<i>East African cassava mosaic Cameroon virus</i>			
East African cassava mosaic Cameroon virus-Cameroon [Cameroon:1998]	AF112354	AF112355	EACMCV-CM[CM:98]
East African cassava mosaic Cameroon virus-Cameroon [Cameroon:KO:1998]	AY211887		EACMCV-CM[CM:KO:98]

Table 1 continued

East African cassava mosaic Cameroon virus-Cameroon [Côte d'Ivoire:1998]	AF259896	AF259897	EACMCV-CM[CI:98]
East African cassava mosaic Cameroon virus-Cameroon [Nigeria:Kano]	AJ867444		EACMCV-CM[NG:Kan]
East African cassava mosaic Cameroon virus-Tanzania [Tanzania:1:2001]	AY795983	AY795989	EACMCV-TZ[TZ:1:01]
East African cassava mosaic Cameroon virus-Tanzania [Tanzania:7:2001]	AY795984		EACMCV-TZ[TZ:7:01]
<i>East African cassava mosaic Kenya virus</i>			
East African cassava mosaic Kenya virus-[Kenya:Kathiana:K300:2002]	AJ717580	AJ704965	EACMKV-[KE:Kat:K300:02]
East African cassava mosaic Kenya virus-[Kenya:Kathiani:K301:2002]	AJ717573		EACMKV-[KE:Kat:K301:02]
East African cassava mosaic Kenya virus-[Kenya:Kehancha:K229:2002]	AJ717578	AJ704968	EACMKV-[KE:Keh:K229:02]
East African cassava mosaic Kenya virus-[Kenya:Kehancha:K230:2002]	AJ717579	AJ704967	EACMKV-[KE:Keh:K230:02]
East African cassava mosaic Kenya virus-[Kenya:Kehancha:K238:2002]	AJ717577	AJ704969	EACMKV-[KE:Keh:K238:02]
East African cassava mosaic Kenya virus-[Kenya:Matuu:K307:2002]	AJ717576		EACMKV-[KE:Mat:K307:02]
East African cassava mosaic Kenya virus-[Kenya:Matuu:K308:2002]	AJ717574	AJ704972	EACMKV-[KE:Mat:K308:02]
East African cassava mosaic Kenya virus-[Kenya:Matuu:K310:2002]	AJ717575		EACMKV-[KE:Mat:K310:02]
East African cassava mosaic Kenya virus-[Kenya:Migori:K228:2002]	AJ717582	AJ704966	EACMKV-[KE:Mig:K228:02]
East African cassava mosaic Kenya virus-[Kenya:Migori:K261:2002]	AJ717581	AJ704970	EACMKV-[KE:Mig:K261:02]
East African cassava mosaic Kenya virus-[Kenya:Mitaboni:K298:2002]	AJ717572	AJ704971	EACMKV-[KE:Mit:K298:02]
East African cassava mosaic Kenya virus-[Kenya:Tala:K302:2002]	AJ717569		EACMKV-[KE:Tal:K302:02]
East African cassava mosaic Kenya virus-[Kenya:Tala:K303:2002]	AJ717570		EACMKV-[KE:Tal:K303:02]
East African cassava mosaic Kenya virus-[Kenya:Tala:K304:2002]	AJ717571		EACMKV-[KE:Tal:K304:02]
<i>East African cassava mosaic Malawi virus</i>			
East African cassava mosaic Malawi virus-[Malawi:K:1996]	AJ006460		EACMMV-[MW:K:96]
East African cassava mosaic Malawi virus-[Malawi:MH:1996]	AJ006459		EACMMV-[MW:MH:96]
<i>East African cassava mosaic virus</i>			
East African cassava mosaic virus-Kenya [Kenya:Boa:K48:2001]	AJ717542	AJ704949	EACMV-KE[KE:Boa:K48:01]
East African cassava mosaic virus-Kenya [Kenya:Boa:K49:2001]	AJ717539		EACMV-KE[KE:Boa:K49:01]
East African cassava mosaic virus-Kenya [Kenya:Boundary:K36:2001]	AJ717554		EACMV-KE[KE:Bou:K36:01]
East African cassava mosaic virus-Kenya [Kenya:K2B:1996]	AJ006458		EACMV-KE[KE:K2B:96]
East African cassava mosaic virus-Kenya [Kenya:Katumani:K24:2001]	AJ717557	AJ704936	EACMV-KE[KE:Kat:K24:01]
East African cassava mosaic virus-Kenya [Kenya:Kibaoni:K29:2001]	AJ717551	AJ704939	EACMV-KE[KE:Kib:K29:01]

Table 1 continued

East African cassava mosaic virus-Kenya [Kenya:Kinyumbini:K53:2001]	AJ717536		EACMV- KE[KE:Kin:K53:01]
East African cassava mosaic virus-Kenya [Kenya:Kitui:K322:2002]	AJ717556		EACMV- KE[KE:Kit:K322:02]
East African cassava mosaic virus-Kenya [Kenya:Kitui:K325:2002]	AJ717548	AJ704937	EACMV- KE[KE:Kit:K325:02]
East African cassava mosaic virus-Kenya [Kenya:Kwale:K211:2002]		AJ704935	EACMV-KE [KE:Kwa:K211:02]
East African cassava mosaic virus-Kenya [Kenya:Mamba:K208:2002]	AJ717540	AJ704952	EACMV-KE [KE:Mam:K208:02]
East African cassava mosaic virus-Kenya [Kenya:Migori:K268:2002]	AJ717558	AJ704938	EACMV-KE [KE:Mig:K268:02]
East African cassava mosaic virus-Kenya [Kenya:Migwani:K312:2002]	AJ717547		EACMV-KE [KE:Mig:K312:02]
East African cassava mosaic virus-Kenya [Kenya:Migwani:K313:2002]	AJ717549		EACMV-KE [KE:Mig:K313:02]
East African cassava mosaic virus-Kenya [Kenya:Migwani:K315:2002]	AJ717550		EACMV-KE [KE:Mig:K315:02]
East African cassava mosaic virus-Kenya [Kenya:Misakwakwani:K25:2001]	AJ717538	AJ704950	EACMV- KE[KE:Mis:K25:01]
East African cassava mosaic virus-Kenya [Kenya:Misakwakwani:K27:2001]	AJ717537	AJ704951	EACMV- KE[KE:Mis:K27:01]
East African cassava mosaic virus-Kenya [Kenya:Msabaha-Kari:K16:2001]	AJ717543		EACMV- KE[KE:Msa:K16:01]
East African cassava mosaic virus-Kenya [Kenya:Msambweni:K197:2002]	AJ717555	AJ704973	EACMV-KE [KE:Msa:K197:02]
East African cassava mosaic virus-Kenya [Kenya:Msambweni:K201:2002]	AJ717541	AJ704953	EACMV-KE [KE:Msa:K201:02]
East African cassava mosaic virus-Kenya [Kenya:Mwezangombe:K9:2001]	AJ717545		EACMV- KE[KE:Mwe:K9:01]
East African cassava mosaic virus-Kenya [Kenya:Perani:K41:2001]	AJ717544		EACMV- KE[KE:Per:K41:01]
East African cassava mosaic virus-Kenya [Kenya:Sharian:K6:2001]	AJ717546		EACMV- KE[KE:Sha:K6:01]
East African cassava mosaic virus-Kenya [Kenya:Shirachi:K33:2001]	AJ717553		EACMV- KE[KE:Shi:K33:01]
East African cassava mosaic virus-Kenya [Kenya:Shirachi:K35:2001]	AJ717552	AJ704934	EACMV- KE[KE:Shi:K35:01]
East African cassava mosaic virus-Kenya [Tanzania:Dar Es Salaam:1996]	Z83256		EACMV- KE[TZ:Dar:96]
East African cassava mosaic virus-Kenya [Tanzania:M]	AY795986		EACMV-KE[TZ:M]
East African cassava mosaic virus-Kenya [Tanzania:T]	AY795985		EACMV-KE[TZ:T]
East African cassava mosaic virus-Kenya [Uganda:1:1997]		AF230375	EACMV-KE[UG:1:97]
East African cassava mosaic virus-Tanzania [Tanzania:YV]	AY795987		EACMV-TZ[TZ:YV]
East African cassava mosaic virus-Uganda [Kenya:Bungoma:K78:2002]	AJ717525		EACMV- UG[KE:Bun:K78:02]
East African cassava mosaic virus-Uganda [Kenya:Bungoma:K79:2002]	AJ717529	AJ704958	EACMV- UG[KE:Bun:K79:02]
East African cassava mosaic virus-Uganda [Kenya:Bungoma:K81:2002]	AJ717523	AJ704959	EACMV- UG[KE:Bun:K81:02]
East African cassava mosaic virus-Uganda [Kenya:Busia:K115:2002]	AJ717516	AJ704963	EACMV-UG [KE:Bus:K115:02]
East African cassava mosaic virus-Uganda [Kenya:Busia:K72:2002]	AJ717527	AJ704974	EACMV- UG[KE:Bus:K72:02]

Table 1 continued

East African cassava mosaic virus-Uganda [Kenya:Busia:K73:2002]	AJ717532		EACMV- UG[KE:Bus:K73:02]
East African cassava mosaic virus-Uganda [Kenya:Busia:K90:2002]	AJ717531	AJ704962	EACMV- UG[KE:Bus:K90:02]
East African cassava mosaic virus-Uganda [Kenya:Funyula:K127:2002]	AJ717517		EACMV-UG [KE:Fun:K127:02]
East African cassava mosaic virus-Uganda [Kenya:Katumani:K23:2001]	AJ717534	AJ704960	EACMV- UG[KE:Kat:K23:01]
East African cassava mosaic virus-Uganda [Kenya:Malaba:K108:2002]	AJ717528		EACMV-UG [KE:Mal:K108:02]
East African cassava mosaic virus-Uganda [Kenya:Migori:K223:2002]	AJ717530	AJ704956	EACMV-UG [KE:Mig:K223:02]
East African cassava mosaic virus-Uganda [Kenya:Migori:K262:2002]	AJ717522	AJ704955	EACMV-UG [KE:Mig:K262:02]
East African cassava mosaic virus-Uganda [Kenya:Mumias:K66:2002]	AJ717524	AJ704954	EACMV-UG [KE:Mum:K66:02]
East African cassava mosaic virus-Uganda [Kenya:Mumias:K67:2002]	AJ717526		EACMV-UG [KE:Mum:K67:02]
East African cassava mosaic virus-Uganda [Kenya:Sega:K136:2002]	AJ717520		EACMV-UG [KE:Seg:K136:02]
East African cassava mosaic virus-Uganda [Kenya:Sega:K137:2002]	AJ717518	AJ704964	EACMV-UG [KE:Seg:K137:02]
East African cassava mosaic virus-Uganda [Kenya:Ugunja:K139:2002]	AJ717519		EACMV-UG [KE:Ugu:K139:02]
East African cassava mosaic virus-Uganda [Kenya:Ugunja:K140:2002]	AJ717521	AJ704957	EACMV-UG [KE:Ugu:K140:02]
East African cassava mosaic virus-Uganda [Kenya:Wote:K277:2002]	AJ717533		EACMV-UG [KE:Wot:K277:02]
East African cassava mosaic virus-Uganda [Kenya:Wote:K282:2002]	AJ717535	AJ704961	EACMV-UG [KE:Wot:K282:02]
East African cassava mosaic virus-Uganda [Tanzania:10]	AY795988		EACMV-UG[TZ10]
East African cassava mosaic virus-Uganda [Uganda:Mild2:1997]	AF126804		EACMV- UG[UG:Mld2:97]
East African cassava mosaic virus-Uganda [Uganda:Mild3:1997]		AF126805	EACMV- UG[UG:Mld3:97]
East African cassava mosaic virus-Uganda [Uganda:Otuboi:1996]	Z83257		EACMV-UG [UG:Otu:96]
East African cassava mosaic virus-Uganda [Uganda:Severe2:1997]	AF126806		EACMV- UG[UG:Svr2:97]
East African cassava mosaic virus-Uganda [Uganda:Severe3:1997]		AF126807, AF230374	EACMV- UG[UG:Svr3:97]
<i>East African cassava mosaic Zanzibar virus</i>			
East African cassava mosaic Zanzibar virus- [Kenya:Felunzi:K19:2001]	AJ717562	AJ704942	EACMZV- [KE:Fel:K19:01]
East African cassava mosaic Zanzibar virus- [Kenya:Kasumalini:K18:2001]	AJ717566	AJ704940	EACMZV- [KE:Kas:K18:01]
East African cassava mosaic Zanzibar virus- [Kenya:Kibwezi:K270:2002]	AJ717563	AJ704947	EACMZV- [KE:Kib:K270:02]
East African cassava mosaic Zanzibar virus- [Kenya:Kibwezi:K272:2002]	AJ717565	AJ704945	EACMZV- [KE:Kib:K272:02]
East African cassava mosaic Zanzibar virus- [Kenya:Kibwezi:K275:2002]	AJ717564	AJ704948	EACMZV- [KE:Kib:K275:02]
East African cassava mosaic Zanzibar virus- [Kenya:Kilifi:1999]	AJ516003	AJ628732	EACMZV-[KE:Kil:99]
East African cassava mosaic Zanzibar virus- [Kenya:Kwakadzengo:K3:2001]	AJ717560	AJ704944	EACMZV- [KE:Kwa:K3:01]

Table 1 continued

East African cassava mosaic Zanzibar virus-[Kenya:Kwamugomba:K10:2001]	AJ717567	AJ704943	EACMZV-[KE:Kwa:K10:01]
East African cassava mosaic Zanzibar virus-[Kenya:Machakos:K337:2002]	AJ717583	AJ704946	EACMZV-[KE:Mac:K337:02]
East African cassava mosaic Zanzibar virus-[Kenya:Malindi:K12:2001]	AJ717561		EACMZV-[KE:Mal:K12:01]
East African cassava mosaic Zanzibar virus-[Kenya:Msambweni:K212:2002]	AJ717568	AJ704941	EACMZV-[KE:Msa:K212:02]
East African cassava mosaic Zanzibar virus-[Kenya:Vipingo:K5:2001]	AJ717559		EACMZV-[KE:Vip:K5:01]
East African cassava mosaic Zanzibar virus-[Tanzania:Uguja:1998]	AF422174	AF422175	EACMZV-[TZ:Ugu:98]
<i>Erectites yellow mosaic virus</i>			
Erectites yellow mosaic virus-[Vietnam:Hoabinh:2005]	DQ641698		ErYMV-[VN:Hoa:05]
<i>Eupatorium yellow vein mosaic virus</i>			
Eupatorium yellow vein mosaic virus-[Japan:SOJ3:2000]	AJ438937		EpYVMV-[JR:SOJ3:00]
<i>Eupatorium yellow vein virus</i>			
Eupatorium yellow vein virus-A [Japan:Kumamoto]	AB007990		EpYVV-A[JR:Kum]
Eupatorium yellow vein virus-A [Japan]	E15418		EpYVV-A[JR]
Eupatorium yellow vein virus-B [Japan:MNS2:2000]	AJ438936		EpYVV-B[JR:MNS2:00]
Eupatorium yellow vein virus-C [Japan:Yamaguchi]	AB079766		EpYVV-C[JR:Yam]
<i>Euphorbia leaf curl Guangxi virus</i>			
Euphorbia leaf curl Guangxi virus-[China:Guangxi 35-1:2002]	AM411424		EuLGxCV-[CN:Gx35-1:02]
<i>Euphorbia leaf curl virus</i>			
Euphorbia leaf curl virus-[China:Guangxi 35:2002]	AJ558121		EuLCV-[CN:Gx35:02]
<i>Euphorbia mosaic virus</i>			
Euphorbia mosaic virus-A [Mexico:Yucatan:2004]	DQ318937	DQ318938	EuMV-A[MX:Yuc:04]
Euphorbia mosaic virus-A [Puerto Rico:Jurabo:1991]	AF068642		EuMV-A[PR:Jur:91]
Euphorbia mosaic virus-B [Mexico:Jalasco:2005]	DQ520942		EuMV-B[MX:Jal:05]
<i>Hollyhock leaf crumple virus</i>			
Hollyhock leaf crumple virus-[Egypt:Cairo:1997]	AY036009		HoLCrV-[EG:Cai:97]
Hollyhock leaf crumple virus-[Egypt:Giza]	AF014881		HoLCrV-[EG:Giz]
<i>Honeysuckle yellow vein mosaic virus</i>			
Honeysuckle yellow vein mosaic virus-A [Japan:Fukuoka 1]	AB178945		HYVMV-A[JR:FK1]
Honeysuckle yellow vein mosaic virus-A [Japan:Oita 1]	AB178947		HYVMV-A[JR:OT1]
Honeysuckle yellow vein mosaic virus-A [Japan:Oita 2]	AB178948		HYVMV-A[JR:OT2]
Honeysuckle yellow vein mosaic virus-B [Japan]	AB020781		HYVMV-B[JR]
Honeysuckle yellow vein mosaic virus-C [Japan:Yamaguchi]	AB079765		HYVMV-C[JR:Yam]
Honeysuckle yellow vein mosaic virus-D [Japan:Kagoshima:Tobacco KG5]	AB178949		HYVMV-D[JR:Kag:TobKG5]
<i>Honeysuckle yellow vein virus</i>			
Honeysuckle yellow vein virus-Japan [Japan:Sapporo 1:2000]	AB182261		HYVV-JR[JR:SP1:00]
Honeysuckle yellow vein virus-Kobe [Japan:Hyogo 12:2000]	AB178946		HYVV-Kob[JR:HY12:00]
Honeysuckle yellow vein virus-Kochi [Japan:Kochi:Tomato:2000]	AB055009		HYVV-Koc[JR:KK:Tom:00]

Table 1 continued

Honeysuckle yellow vein virus-United Kingdom [United Kingdom:Norwich 1:1999]	AJ542540		HYVV-UK[UK:Nor1:99]
Honeysuckle yellow vein virus-United Kingdom [United Kingdom:Norwich 2:1999]	AJ543429		HYVV-UK[UK:Nor2:99]
<i>Horsegram yellow mosaic virus</i>			
Horsegram yellow mosaic virus-[India:Coimbatore]	AJ627904	AJ627905	HgYMV-[IN:Coi]
<i>Indian cassava mosaic virus</i>			
Indian cassava mosaic virus-India [India:Maharashtra 2:1988]	AY730035	AY730036	ICMV-IN[IN:Mah2:88]
Indian cassava mosaic virus-India [India:Maharashtra:1988]	AJ314739	AJ314740	ICMV-IN[IN:Mah:88]
Indian cassava mosaic virus-India [India:Trivandrum:1986]	Z24758	Z24759	ICMV-IN[IN:Tri:86]
Indian cassava mosaic virus-Kerala [India:Kerala 2:2002]	AJ575819		ICMV-Ker[IN:Ker2:02]
Indian cassava mosaic virus-Kerala [India:Kerala 3:2002]		AJ575820	ICMV-Ker[IN:Ker3:02]
Indian cassava mosaic virus-Kerala [India:Kerala 6:2002]		AJ512823	ICMV-Ker[IN:Ker6:02]
<i>Ipomea yellow vein virus</i>			
Ipomea yellow vein virus-[Spain:1998]	AJ132548		IYVV-[ES:98]
<i>Kudzu mosaic virus</i>			
Kudzu mosaic virus-[Vietnam:Hoabinh:2005]	DQ641690	DQ641691	KuMV-[VN:Hoa:05]
<i>Lindernia anagallis yellow vein virus</i>			
Lindernia anagallis yellow vein virus-[China:Hainan:2004]	AY795900		LaYVV-[CN:Hn:04]
Lindernia anagallis yellow vein virus-[Vietnam:Hanoi:2005]	DQ641701		LaYVV-[VN:Hn:05]
<i>Ludwigia yellow vein Vietnam virus</i>			
Ludwigia yellow vein Vietnam virus-[Vietnam:Hochiminh:2005]	DQ641699		LuYVVNV-[VN:Hoc:05]
<i>Ludwigia yellow vein virus</i>			
Ludwigia yellow vein virus-[China:Guangxi 37:2003]	AJ965539		LuYVV-[CN:Gx37:03]
Ludwigia yellow vein virus-[Vietnam:Hochiminh:2005]	DQ641708		LuYVV-[VN:Hoc:05]
<i>Luffa yellow mosaic virus</i>			
Luffa yellow mosaic virus-[Vietnam]	AF509739	AF509740	LYMV-[VN]
<i>Macrotidium mosaic Puerto Rico virus</i>			
Macrotidium mosaic Puerto Rico virus-[Puerto Rico:1990]	AY044133	AY044134	MaMPRV-[PR:90]
Macrotidium mosaic Puerto Rico virus-[Puerto Rico:Bean:1998]	AF449192	AF449193	MaMPRV-[PR:Bea:98]
<i>Macrotidium yellow mosaic Florida virus</i>			
Macrotidium yellow mosaic Florida virus-[United States of America:Florida:1985]	AY044135	AY044136	MaYMFV-[US:Flo:85]
<i>Macrotidium yellow mosaic virus</i>			
Macrotidium yellow mosaic virus-[Cuba]	AJ344452		MaYMV-[CU]
<i>Malvastrum leaf curl Guangdong virus</i>			
Malvastrum leaf curl Guangdong virus-[China:Guangdong 6:2004]	AM236779		MaLCuGdV-[CN:Gd6:04]
Malvastrum leaf curl Guangdong virus-[China:Guangdong 9:2004]	AM236780		MaLCuGdV-[CN:Gd9:04]
<i>Malvastrum leaf curl virus</i>			
Malvastrum leaf curl virus-[China:Guangxi 100:Papaya:2005]	AM260699		MaLCV-[CN:Gx100:Pap:05]
Malvastrum leaf curl virus-[China:Guangxi 87:2004]	AJ971263		MaLCV-[CN:Gx87:04]

Table 1 continued

<i>Malvastrum yellow leaf curl virus</i>			
Malvastrum yellow leaf curl virus-[China:Yunnan 193:2003]	AJ971524		MaYLCV-[CN:Yn193:03]
Malvastrum yellow leaf curl virus-[China:Yunnan 194:2003]	AJ971265		MaYLCV-[CN:Yn194:03]
<i>Malvastrum yellow mosaic virus</i>			
Malvastrum yellow mosaic virus-[China:Hainan 36:2004]	AM236755		MaYMV-[CN:Hn36:04]
Malvastrum yellow mosaic virus-[China:Hainan 37:2004]	AM236756		MaYMV-[CN:Hn37:04]
<i>Malvastrum yellow vein virus</i>			
Malvastrum yellow vein virus-[China:Yunnan 47:2001]	AJ457824		MaYVV-[CN:Yn47:01]
Malvastrum yellow vein virus-[China:Yunnan206:Ageratum:2003]	AJ744881		MaYVV-[CN:Yn206:Age:03]
<i>Malvastrum yellow vein Yunnan virus</i>			
Malvastrum yellow vein Yunnan virus-[China:Yunnan160:2003]	AJ786711		MaYVVV-[CN:Yn160:03]
<i>Melon chlorotic leaf curl virus</i>			
Melon chlorotic leaf curl virus-Costa Rica [Costa Rica:Guanacaste:1998]	AY064391	AF440790	MCLCuV-CR[CR:Gua:98]
Melon chlorotic leaf curl virus-Guatemala [Guatemala:2000]	AF325497		MCLCuV-GT[GT:00]
<i>Merremia mosaic leaf curl virus</i>			
Merremia mosaic virus-Puerto Rico [Puerto Rico:]	AF068636	AY965899	MeMV-PR[PR:]
Merremia mosaic virus-Venezuela [Venezuela:Trujillo]	AY508991	AY508992	MeMV-VE[VE:Tru]
<i>Mimosa yellow leaf curl virus</i>			
Mimosa yellow leaf curl virus-[Vietnam:Binhdung:2005]	DQ641695		MiYLCV-[VN:Bin:05]
<i>Mungbean yellow mosaic India virus</i>			
Mungbean yellow mosaic India virus-[Bangladesh:1998]	AF314145		MYMIV-[BD:98]
Mungbean yellow mosaic India virus-[India:Sriganganagar:Mungbean 1:1996]	AF416742	AF416741	MYMIV-[IN:Sri:Mg1:96]
Mungbean yellow mosaic India virus-[India:Akola]	AY271893	AY271894	MYMIV-[IN:Ako]
Mungbean yellow mosaic India virus-[India:Anand:Cowpea MBK-A25:2005]	AY937195	AY937196	MYMIV-[IN:Ana:CpMBKA25:05]
Mungbean yellow mosaic India virus-[India:Jabalpur]	AJ416349	AJ420331	MYMIV-[IN:Jab]
Mungbean yellow mosaic India virus-[India:Kanpur:Cowpea:2005]	DQ389154		MYMIV-[IN:Kan:Cp:05]
Mungbean yellow mosaic India virus-[India:New Delhi:Blackgram 3:1991]	AF126406	AF142440	MYMIV-[IN:ND:Bg3:91]
Mungbean yellow mosaic India virus-[India:New Delhi:Cowpea7:1998]	AF481865	AF503580	MYMIV-[IN:ND:Cp7:98]
Mungbean yellow mosaic India virus-[India:New Delhi:Cowpea:2004]		AY939925	MYMIV-[IN:ND:Cp:04]
Mungbean yellow mosaic India virus-[India:New Delhi:Cowpea:2005]	DQ389153		MYMIV-[IN:ND:Cp:05]
Mungbean yellow mosaic India virus-[India:New Delhi:Soybean 2:1999]	AY049772	AY049771	MYMIV-[IN:ND:Sb2:99]
Mungbean yellow mosaic India virus-[India:Punjab:2005]	DQ400847		MYMIV-[IN:Pun:05]
Mungbean yellow mosaic India virus-[India:Varanasi:Cowpea]	AY618902		MYMIV-[IN:Var:Cp]
Mungbean yellow mosaic India virus-[India:Varanasi:Dolichos]	AY547317	DQ061273	MYMIV-[IN:Var:Dol]
Mungbean yellow mosaic India virus-[Nepal:Lalitpur]	AY271895		MYMIV-[NP:Lal]
Mungbean yellow mosaic India virus-[Pakistan:106]	AJ512498		MYMIV-[PK:106]
Mungbean yellow mosaic India virus-[Pakistan:130.12]	AJ512497		MYMIV-[PK:130.12]

Table 1 continued

Mungbean yellow mosaic India virus-[Pakistan:130.7]	AJ512496		MYMIV-[PK:130.7]
Mungbean yellow mosaic India virus-[Pakistan:14]	AJ512495		MYMIV-[PK:14]
Mungbean yellow mosaic India virus-[Pakistan:Cowpea:2000]	AY269990		MYMIV-[PK:Cp:00]
Mungbean yellow mosaic India virus-[Pakistan:Islamabad:2000]	AY269992		MYMIV-[PK:Isl:00]
<i>Mungbean yellow mosaic virus</i>			
Mungbean yellow mosaic virus-[India:Haryana:2001]	AY271896		MYMV-[IN:Har:01]
Mungbean yellow mosaic virus-[India:Madurai:Soybean 2]		AJ582267	MYMV-[IN:Mad:Sb2]
Mungbean yellow mosaic virus-[India:Madurai:Soybean]	AJ421642	AJ867554	MYMV-[IN:Mad:Sb]
Mungbean yellow mosaic virus-[India:Maharashtra:Soybean:1999]	AF314530		MYMV-[IN:Mah:Sb:99]
Mungbean yellow mosaic virus-[India:Namakkal B1:2005]		DQ865202	MYMV-[IN:NamB1:05]
Mungbean yellow mosaic virus-[India:Namakkal B2:2005]		DQ865203	MYMV-[IN:NamB2:05]
Mungbean yellow mosaic virus-[India:Vamban:2005]	DQ400848	DQ400849	MYMV-[IN:Vam:05]
Mungbean yellow mosaic virus-[India:Vamban:Vigna KA21]		AJ439059	MYMV-[IN:Vam:VigKA21]
Mungbean yellow mosaic virus-[India:Vamban:Vigna KA27]		AF262064	MYMV-[IN:Vam:VigKA27]
Mungbean yellow mosaic virus-[India:Vamban:Vigna KA28]		AJ439058	MYMV-[IN:Vam:VigKA28]
Mungbean yellow mosaic virus-[India:Vamban:Vigna KA34]		AJ439057	MYMV-[IN:Vam:VigKA34]
Mungbean yellow mosaic virus-[India:Vigna]	AJ132575	AJ132574	MYMV-[IN:Vig]
Mungbean yellow mosaic virus-[Pakistan:Islamabad:Soybean:2000]	AY269991		MYMV-[PK:Isl:Sb:00]
Mungbean yellow mosaic virus-[Thailand:Mungbean 1]	D14703	D14704	MYMV-[TH:Mg1]
Mungbean yellow mosaic virus-[Thailand:Mungbean 2]	AB017341		MYMV-[TH:Mg2]
<i>Okra yellow crinkle virus</i>			
Okra yellow crinkle virus-[Mali:01:2005]	DQ902715		OYCrV-[ML:01:05]
Okra yellow crinkle virus-[Mali:02:2005]	DQ875879		OYCrV-[ML:02:05]
<i>Okra yellow mosaic Mexico virus</i>			
Okra yellow mosaic Mexico virus-[Mexico:Mazatepec 3:2004]	DQ022611		OYMMV-[MX:Maz3:04]
<i>Okra yellow mottle Iguala virus</i>			
Okra yellow mottle Iguala virus-[Mexico:Iguala]	AY751753		OYMoIV-[MX:Igu]
<i>Okra yellow vein mosaic virus</i>			
Okra yellow vein mosaic virus-[Pakistan:Faisalabad 201:1995]	AJ002451		OYVMV-[PK:Fai201:95]
<i>Papaya leaf curl China virus</i>			
Papaya leaf curl China virus-Ageratum [China:Guangxi 10:Ageratum:2002]	AJ558125		PaLCuCNV-Age[CN:Gx10:02]
Papaya leaf curl China virus-Ageratum [China:Guangxi 43:Tomentosa:2003]	AJ876548		PaLCuCNV-Age[CN:Gx43:Toa:03]
Papaya leaf curl China virus-Ageratum [China:Guangxi 7:Ageratum:2002]	AJ811439		PaLCuCNV-Age[CN:Gx7:02]
Papaya leaf curl China virus-Papaya [China:Guangxi 2:2002]	AJ558123		PaLCuCNV-Pap[CN:Gx2:02]
Papaya leaf curl China virus-Papaya [China:Guangxi 22:Tomato:2002]	AJ704604		PaLCuCNV-Pap[CN:Gx22:Tom:02]

Table 1 continued

Papaya leaf curl China virus-Papaya [China:Guangxi 30:Tomato:2002]	AJ558117		PaLCuCNV-Pap [CN:Gx30:Tom:02]
Papaya leaf curl China virus-Papaya [China:Guangxi 4:2002]	AJ811914		PaLCuCNV-Pap [CN:Gx4:Age:024:02]
Papaya leaf curl China virus-Tomato [China:Guangxi 12:Tomato:2002]	AJ558116		PaLCuCNV-Tom [CN:Gx12:02]
Papaya leaf curl China virus-Tomato [China:Guangxi 8:Ageratum:2002]	AJ558124		PaLCuCNV-Tom [CN:Gx8:Age:02]
Papaya leaf curl China virus-Tomato [Vietnam:Hatay:Tobacco:2005]	DQ641700		PaLCuCNV-Tom [VN:Hat:Tb:05]
<i>Papaya leaf curl Guangdong virus</i>			
Papaya leaf curl Guangdong virus-[China:Guangdong 2:2002]	AJ558122		PaLCuGuV-[CN:Gd2:02]
Papaya leaf curl Guangdong virus-[China:Guangzhou:GT:2004]	AY650283		PaLCuGuV-[CN:Gz:GT:04]
<i>Papaya leaf curl virus</i>			
Papaya leaf curl virus-India [India:Lucknow]	Y15934		PaLCuV-IN[IN:Luc]
Papaya leaf curl virus-Pakistan [Pakistan:Cotton:2002]	AJ436992		PaLCuV-PK[PK:Cot:02]
<i>Pepper golden mosaic virus</i>			
Pepper golden mosaic virus-Costa Rica [Costa Rica]	AF149227		PepGMV-CR[CR]
Pepper golden mosaic virus-Costa Rica [United States of America:Serano:1989]	AY928516	AY928517	PepGMV-CR[US:Ser:89]
Pepper golden mosaic virus-United States of America [Mexico:Tamaulipas]	U57457	AF499442	PepGMV-US[MX:Tam]
Pepper golden mosaic virus-United States of America [United States of America:Distortion:1987]	AY928514	AY928515	PepGMV-US[US:Dis:87]
Pepper golden mosaic virus-United States of America [United States of America:Mosaic:1987]	AY928512	AY928513	PepGMV-US[US:Mos:87]
<i>Pepper huasteco yellow vein virus</i>			
Pepper huasteco yellow vein virus-[Mexico:Sinaloa:1988]	AY044162	AY044163	PHYVV-[MX:Sin:88]
Pepper huasteco yellow vein virus-[Mexico:Tamaulipas]	X70418	X70419	PHYVV-[MX:Tam]
<i>Pepper leaf curl Bangladesh virus</i>			
Pepper leaf curl Bangladesh virus-Bangladesh [Bangladesh:Bogra:1999]	AF314531		PepLCBDV-BD[BD:Bog:99]
Pepper leaf curl Bangladesh virus-Pakistan [Pakistan:Khanewal:2004]	DQ116881		PepLCBDV-PK[PK:Kha:04]
<i>Pepper leaf curl Lahore virus</i>			
Pepper leaf curl Lahore virus-[Pakistan:Lahore:2004]	AM404179		PepLCLV-[PK:Lah:04]
<i>Pepper leaf curl virus</i>			
Pepper leaf curl virus-Malaysia [Malaysia:Klang:1997]	AF414287		PepLCV-MY[MY:Kla:97]
Pepper leaf curl virus-Thailand [Thailand]	AF134484		PepLCV-TH[TH]
<i>Pepper yellow leaf curl Indonesia virus</i>			
Pepper yellow leaf curl Indonesia virus-A [Indonesia:Ageratum:2005]	AB267838	AB267839	PepLCIV-A[ID:Age:05]
Pepper yellow leaf curl Indonesia virus-A [Indonesia:Tomato:2005]	AB267836	AB267837	PepLCIV-A[ID:Tom:05]
Pepper yellow leaf curl Indonesia virus-B [Indonesia:2005]	AB267834	AB267835	PepLCIV-B[ID:05]
<i>Pepper yellow vein Mali virus</i>			
Pepper yellow vein Mali virus-[Mali]	AY502935		PepYVMV-[ML]

Table 1 continued

Potato yellow mosaic Panama virus			
Potato yellow mosaic Panama virus-[Panama:Divisa:Tomato]	Y15034	Y15033	PYMPV-[PA:Div:Tom]
Potato yellow mosaic virus			
Potato yellow mosaic virus-Potato [Venezuela]	D00940	D00941	PYMV-Po[VE]
Potato yellow mosaic virus-Tomato [Guadeloupe:Tomato]	AY120882	AY120883	PYMV-To[GP:Tom]
Potato yellow mosaic virus-Tomato [Puerto Rico:Tomato:2004]	AY965897	AY965898	PYMV-To[PR:Tom:04]
Potato yellow mosaic virus-Trinidad [Trinidad & Tobago:Tomato]	AF039031	AF039032	PYMV-TT[TT:Tom]
Radish leaf curl virus			
Radish leaf curl virus-[India:Varanasi:2005]	EF175733		RaLCV-[IN:Var:03]
Rhynchosia golden mosaic Sinaloa virus			
Rhynchosia golden mosaic Sinaloa virus-[Mexico:Sinaloa:2005]	DQ406672	DQ406673	RhGMSV-[MX:Sin:05]
Rhynchosia golden mosaic virus			
Rhynchosia golden mosaic virus-Honduras [Honduras:Comayagua:1999]	AF239671		RhGMV-HN[HN:Com:99]
Rhynchosia golden mosaic virus-Mexico [Mexico:Chiapas:Tobacco]	AF408199		RhGMV-MX[MX:Chi:Tob]
Rhynchosia golden mosaic virus-Soybean [Mexico:Sinaloa:2005]	DQ347950	DQ356429	RhGMV-Sb[MX:Sin:05]
Senecio yellow mosaic virus			
Senecio yellow mosaic virus-[China:Guangxi 46:2003]	AJ876550		SeYMV-[CN:Gx46:03]
Sida golden mosaic Costa Rica virus			
Sida golden mosaic Costa Rica virus-[Costa Rica]	X99550	X99551	SiGMCRV-[CR]
Sida golden mosaic Florida virus			
Sida golden mosaic Florida virus-[United States of America:Homestead A1]	U77963		SiGMFV-[US:Hom:A1]
Sida golden mosaic Honduras virus			
Sida golden mosaic Honduras virus-[Honduras:Yellow vein]		AJ250731	SiGMHV-[HN:YV]
Sida golden mosaic Honduras virus-[Honduras]	Y11097	Y11098	SiGMHV-[HN]
Sida golden mosaic virus			
Sida golden mosaic virus-[United States of America:Florida]	AF049336	AF039841	SiGMV-[US:Flo]
Sida golden yellow vein virus			
Sida golden yellow vein virus-[Cuba:Havana]	AJ577395		SiGYVV-[CU:Hav]
Sida golden yellow vein virus-[United States of America:Homestead:A11]	U77964		SiGYVV-[US:Hom:A11]
Sida leaf curl virus			
Sida leaf curl virus-[China:Hainan 57:2004]	AM050730		SiLCuV-[CN:Hn57:04]
Sida leaf curl virus-[Vietnam:Thanhhoa:61:2005]	DQ641706		SiLCuV-[VN:Tan61:05]
Sida leaf curl virus-[Vietnam:Thanhhoa:62:2005]	DQ641707		SiLCuV-[VN:Tan62:05]
Sida micrantha mosaic virus			
Sida micrantha mosaic virus-[Brazil:A2B2]	AJ557451	AJ557453	SiMMV-[BR:A2B2]
Sida micrantha mosaic virus-[Brazil:B1]		AJ557452	SiMMV-[BR:B1]
Sida mottle virus			
Sida mottle virus-Micrantha [Brazil:A1B3]	AJ557450	AJ557454	SiMoV-mic[BR:A1B3]
Sida mottle virus-Rhombifolia [Brazil:Vicosal:1999]	AY090555		SiMoV-rho[BR:Vic1:99]

Table 1 continued

<i>Sida yellow mosaic China virus</i>			
Sida yellow mosaic China virus-[China:Hainan 7:Ageratum:2003]	AM048837		SiYMCNV-[CN:Hn7:Age:03]
Sida yellow mosaic China virus-[China:Hainan 8:2003]	AJ810096		SiYMCNV-[CN:Hn8:03]
<i>Sida yellow mosaic virus</i>			
Sida yellow mosaic virus-[Brazil:Vicosia2:1999]	AY090558		SiYMV-[BR:Vic2:99]
<i>Sida yellow mosaic Yucatan virus</i>			
Sida yellow mosaic Yucatan virus-[Mexico:Yucatan:2005]	DQ875872	DQ875873	SiYMYuV-[MX:Yuc:05]
<i>Sida yellow vein Madurai virus</i>			
Sida yellow vein Madurai virus-[India:Madurai:2005]	AM259382		SiYVMaV-[IN:Mad:05]
<i>Sida yellow vein Vietnam virus</i>			
Sida yellow vein Vietnam virus-[Vietnam:Hanoi:2005]	DQ641696		SiYVVNV-[VN:Han:05]
<i>Sida yellow vein virus</i>			
Sida yellow vein virus-[Honduras]	Y11099	Y11100-1	SiYVV-[HN]
<i>Siegesbeckia yellow vein Guangxi virus</i>			
Siegesbeckia yellow vein Guangxi virus-[China:Guangxi 111:2005]	AM238692		SbYVGxV-[CN:Gx111:05]
<i>Siegesbeckia yellow vein virus</i>			
Siegesbeckia yellow vein virus-[China:Guangdong 13:2004]	AM183224		SbYVV-[CN:Gd13:04]
Siegesbeckia yellow vein virus-[China:Guangdong 24:2004]	AM230634		SbYVV-[CN:Gd24:04]
Siegesbeckia yellow vein virus-[China:Guangdong 27:2004]	AM230635		SbYVV-[CN:Gd27:04]
<i>South African cassava mosaic virus</i>			
South African cassava mosaic virus-[Madagascar:12]	AJ422132		SACMV-[MG:12]
South African cassava mosaic virus-[South Africa]	AF155806	AF155807	SACMV-[ZA]
South African cassava mosaic virus-[Zimbabwe:Muzarabani]	AJ575560		SACMV-[ZW:Muz]
<i>Soybean blistering mosaic virus</i>			
Soybean blistering mosaic virus-[Argentina:NOA:2005]	EF016486		SbBMV-[AR:NOA:05]
<i>Soybean crinkle leaf virus</i>			
Soybean crinkle leaf virus-[Japan]	AB050781		SbCLV-[JR]
<i>Spilanthus yellow vein virus</i>			
Spilanthus yellow vein virus-[Vietnam:Dalat:2005]	DQ641694		SpYVV-[VN:Dal:05]
<i>Squash leaf curl China virus</i>			
Squash leaf curl China virus-China [China:Guangxi:2002]	AB027465		SLCCNV-CN[CN:Gx:02]
Squash leaf curl China virus-China [China:Guangxi25:2005]	AM260206	AM260208	SLCCNV-CN[CN:Gx25:05]
Squash leaf curl China virus-China [China:Hainan61:2005]	AM260205	AM260207	SLCCNV-CN[CN:Hn61:05]
Squash leaf curl China virus-China [Vietnam:B]	AF509743	AF509742	SLCCNV-CN[VN:B]
Squash leaf curl China virus-China [Vietnam:K]	AF509741		SLCCNV-CN[VN:K]
Squash leaf curl China virus-India [India:Coimbatore:Pumpkin]	AY184487	AY184488	SLCCNV-IN[IN:Coi:Pum]
Squash leaf curl China virus-India [India:Lucknow:Pumpkin]	DQ026296		SLCCNV-IN[IN:Luc:Pum]
Squash leaf curl China virus-India [Pakistan:Lahore:2004]	AM286794		SLCCNV-IN[PK:Lah:04]

Table 1 continued

<i>Squash leaf curl Philippines virus</i>			
Squash leaf curl Philippines virus-Philippines [Philippines:Munoz]	AB085793	AB085794	SLCPHV-PH[PH:Mun]
Squash leaf curl Philippines virus-Taiwan [Taiwan:Pumpkin:05]	DQ866135		SLCPHV-TW[TW:Pum;05]
<i>Squash leaf curl virus</i>			
Squash leaf curl virus-[United States of America:Imperial Valley:1979]	M38183	M38182	SLCV-[US:Imp:79]
<i>Squash leaf curl Yunnan virus</i>			
Squash leaf curl Yunnan virus-[China:Yunnan 23:2000]	AJ420319		SLCYNV-[CN:Y23:00]
<i>Squash mild leaf curl virus</i>			
Squash mild leaf curl virus-[United States of America:Imperial Valley:1979]	AF421552	AF421553	SMLCV-[US:Imp:79]
<i>Sri Lankan cassava mosaic virus</i>			
Sri Lankan cassava mosaic virus-India [India:Adivaram]	AJ579307	AJ579308	SLCMV-IN[IN:Adi]
Sri Lankan cassava mosaic virus-India [India:Kattukuda]		AJ575821	SLCMV-IN[IN:Kat]
Sri Lankan cassava mosaic virus-India [India:Kerala 15]	AJ890224		SLCMV-IN[IN:Ker15]
Sri Lankan cassava mosaic virus-India [India:Kerala 17]	AJ890225		SLCMV-IN[IN:Ker17]
Sri Lankan cassava mosaic virus-India [India:Kerala C4]	AJ890226		SLCMV-IN[IN:KerC4]
Sri Lankan cassava mosaic virus-India [India:MuvattupuCha:2004]		AJ575820	SLCMV-IN[IN:Muv:04]
Sri Lankan cassava mosaic virus-India [India:Salem]	AJ607394		SLCMV-IN[IN:Sal]
Sri Lankan cassava mosaic virus-India [India:Tamil Nadu 2]	AJ890227		SLCMV-IN[IN:Tam2]
Sri Lankan cassava mosaic virus-India [India:Tamil Nadu 6]	AJ890228		SLCMV-IN[IN:Tam6]
Sri Lankan cassava mosaic virus-India [India:Tamil Nadu 7]	AJ890229		SLCMV-IN[IN:Tam7]
Sri Lankan cassava mosaic virus-Sri Lanka [Sri Lanka:Colombo:1998]	AJ314737	AJ314738	SLCMV-LK[LK:Col:98]
<i>Stachytarpheta leaf curl virus</i>			
Stachytarpheta leaf curl virus-[China:Hainan 30:2004]	AJ810156		StaLCuV-[CN:Hn30:04]
Stachytarpheta leaf curl virus-[China:Hainan 34:2004]	AJ810157		StaLCuV-[CN:Hn34:04]
Stachytarpheta leaf curl virus-[China:Hainan 5.4:2001]	AJ564743		StaLCuV-[CN:Hn5.4:01]
Stachytarpheta leaf curl virus-[China:Hainan 5:2001]	AJ495814		StaLCuV-[CN:Hn5:01]
Stachytarpheta leaf curl virus-[China:Hainan 6.1:2001]	AJ564742		StaLCuV-[CN:Hn6.1:01]
<i>Sweet potato leaf curl Georgia virus</i>			
Sweet potato leaf curl Georgia virus-[United States:Georgia:16]	AF326775		SPLCGV-[US:Geo:16]
<i>Sweet potato leaf curl virus</i>			
Sweet potato leaf curl virus-Italy [Italy:Sicily:2002]	AJ586885		SPLCV-IT[IT:Sic:02]
Sweet potato leaf curl virus-United States of America [United States of America:Louisiana:1994]	AF104036		SPLCV-[US:Lou:94]
<i>Tobacco curly shoot virus</i>			
Tobacco curly shoot virus-[China:Yunnan 1:1999]	AF240675		TbCSV-[CN:Yn1:99]
Tobacco curly shoot virus-[China:Yunnan 282:Ageratum:2003]	AJ971266		TbCSV-[CN:Yn282:Age:03]
Tobacco curly shoot virus-[China:Yunnan 35:2001]	AJ420318		TbCSV-[CN:Yn35:01]
Tobacco curly shoot virus-[China:Yunnan 41:Tomato:2001]	AJ457986		TbCSV-[CN:Yn41:Tom:01]

Table 1 continued

<i>Tobacco leaf curl Cuba virus</i>			
Tobacco leaf curl Cuba virus-[Cuba:Taguasco:2005]	AM050143		TbLCuCUV-[CU:Tag:05]
<i>Tobacco leaf curl Japan virus</i>			
Tobacco leaf curl Japan virus-[Japan:3]	AB079689		TbLCJV-[JR:3]
Tobacco leaf curl Japan virus-[Japan:Nara:Tomato:2]	AB055008		TbLCJV-[JR:Nar:Tom:2]
Tobacco leaf curl Japan virus-[Japan:Nara]	AB028604		TbLCJV-[JR:Nar]
<i>Tobacco leaf curl Yunnan virus</i>			
Tobacco leaf curl Yunnan virus-[China:Yunnan 136:2002]	AJ512761		TbLCYnV-[CN:Yn136:02]
Tobacco leaf curl Yunnan virus-[China:Yunnan 143:2002]	AJ512762		TbLCYnV-[CN:Yn143:02]
Tobacco leaf curl Yunnan virus-[China:Yunnan 161:Tomato:2003]	AJ566744		TbLCYnV-[CN:Yn161:Tom:03]
Tobacco leaf curl Yunnan virus-[China:Yunnan 283:Ageratum:2004]	AJ971267		TbLCYnV-[CN:Yn283:Age:04]
Tobacco leaf curl Yunnan virus-[China:Yunnan 3:1999]	AF240674		TbLCYnV-[CN:Yn3:99]
<i>Tobacco leaf curl Zimbabwe virus</i>			
Tobacco leaf curl Zimbabwe virus-[Zimbabwe]	AF350330		TbLCZV-[ZW]
<i>Tomato chino La Paz virus</i>			
Tomato chino La Paz virus-A [Mexico:Baja La Paz:2002]	AY339618		ToChLPV-A[MX:BLP:02]
Tomato chino La Paz virus-B[Mexico:Baja El Carrizal:2002]	AY339619		ToChLPV-B[MX:BEC:02]
Tomato chino La Paz virus-B[Mexico:Sinaloa MM1:2005]	DQ347948		ToChLPV-B[MX:SinMM1:05]
Tomato chino La Paz virus-B[Mexico:Sinaloa MM4:2005]	DQ347949		ToChLPV-B[MX:SinMM4:05]
<i>Tomato chlorotic mottle virus</i>			
Tomato chlorotic mottle virus-Bahia [Brazil:Seabra1:1996]	AF490004	AF491306	ToCMoV-BA[BR:Seal:96]
Tomato chlorotic mottle virus-Minas Gerais [Brazil:Betim1:1996]	AY090557		ToCMoV-MG[BR:Bet1:96]
Tomato chlorotic mottle virus-Minas Gerais [Brazil:Igarape1:1996]	DQ336353	DQ336354	ToCMoV-MG[BR:Iga1:96]
<i>Tomato curly stunt virus</i>			
Tomato curly stunt virus-[South Africa:Onderberg:1998]	AF261885		ToCSV-[ZA:Ond:98]
<i>Tomato golden mosaic virus</i>			
Tomato golden mosaic virus-[Brazil:Common:1984]	K02029	K02030	TGMV-[BR:Com:84]
Tomato golden mosaic virus-[Brazil:Yellow Vein]		M73794	TGMV-[BR:YV]
<i>Tomato golden mottle virus</i>			
Tomato golden mottle virus-[Guatemala:R2:1994]	AF132852		ToGMoV-[GT:R2:94]
Tomato golden mottle virus-[Mexico:San Luiz Potosi:2005]		DQ406674	ToGMoV-[MX:SLP:05]
<i>Tomato leaf curl Arusha virus</i>			
Tomato leaf curl Arusha virus-[Tanzania:Tengelu:2005]	DQ519575		ToLCArV-[TZ:Ten:05]
<i>Tomato leaf curl Bangalore virus</i>			
Tomato leaf curl Bangalore virus-A [India:Bangalore 1]	Z48182		ToLCBV-A[IN:Ban1]

Table 1 continued

Tomato leaf curl Bangalore virus-A [India:Kerala IV:2005]	DQ887537		ToLCBV-A[IN:KerIV:05]
Tomato leaf curl Bangalore virus-A [India:Kolar]	AF428255		ToLCBV-A[IN:Kol]
Tomato leaf curl Bangalore virus-B [India:Bangalore 5]	AF295401		ToLCBV-B[IN:Ban5]
Tomato leaf curl Bangalore virus-B [India:Fatehabad:Cotton]	AY456684		ToLCBV-B[IN:Fat:Cot]
Tomato leaf curl Bangalore virus-C [India:Bangalore 4:1997]	AF165098		ToLCBV-C[IN:Ban4:97]
Tomato leaf curl Bangalore virus-C [India:Bangalore:AVT1]	AY428770		ToLCBV-C[IN:Ban:AVT1]
<i>Tomato leaf curl Bangladesh virus</i>			
Tomato leaf curl Bangladesh virus-[Bangladesh:2]	AF188481		ToLCBDV-[BD:2]
<i>Tomato leaf curl China virus</i>			
Tomato leaf curl China virus-Baise [China:Guangxi 32:2002]	AJ558118		ToLCCNV-Bai[CN:Gx32:02]
Tomato leaf curl China virus-Nanning1 [China:Guangxi 16:2002]	AJ704602		ToLCCNV-Nan1[CN:Gx16:02]
Tomato leaf curl China virus-Nanning1 [China:Guangxi 18:2002]	AJ558119		ToLCCNV-Nan1[CN:Gx18:02]
Tomato leaf curl China virus-Nanning2 [China:Guangxi 63:2003]	AJ704603		ToLCCNV-Nan2[CN:Gx63:03]
<i>Tomato leaf curl Comoros virus</i>			
Tomato leaf curl Comoros virus-[Mayotte:Dembeni:2003]	AJ865341		ToLCKMV-[YT:Dem:03]
<i>Tomato leaf curl Guangdong virus</i>			
Tomato leaf curl Guangdong virus-[China:Guangzhou 2:2003]	AY602165		ToLCGuV-[CN:Gz2:03]
<i>Tomato leaf curl Guangxi virus</i>			
Tomato leaf curl Guangxi virus-[China:Guangxi 1:2003]	AM236784		ToLCGxV-[CN:Gx1:03]
Tomato leaf curl Guangxi virus-[China:Guangxi 2:2003]	AM236785		ToLCGxV-[CN:Gx2:03]
Tomato leaf curl Guangxi virus-[China:Guangxi 3:2003]	AM236786		ToLCGxV-[CN:Gx3:03]
<i>Tomato leaf curl Gujarat virus</i>			
Tomato leaf curl Gujarat virus-[India:Mirzapur:1999]	AF449999		ToLCGV-[IN:Mir:99]
Tomato leaf curl Gujarat virus-[India:Vadodara:1999]	AF413671		ToLCGV-[IN:Vad:99]
Tomato leaf curl Gujarat virus-[India:Varanasi:2001]	AY190290	AY190291	ToLCGV-[IN:Var:01]
Tomato leaf curl Gujarat virus-[Nepal:Panchkhal:2000]	AY234383		ToLCGV-[NP:Pan:00]
<i>Tomato leaf curl Hsinchu virus</i>			
Tomato leaf curl Hsinchu virus-[China:Fujian:2005]	EF125190		ToLCHsV-[CN:Fuj:05]
Tomato leaf curl Hsinchu virus-[Taiwan:Hsinchu:2005]	DQ866131		ToLCHsV-[TW:THsi:05]
<i>Tomato leaf curl Java virus</i>			
Tomato leaf curl Java virus-A [Indonesia]	AB100304		ToLCJV-A[ID]
Tomato leaf curl Java virus-B [Indonesia:Ageratum]	AB162141		ToLCJV-B[ID:Age]
<i>Tomato leaf curl Joydebpur virus</i>			
Tomato leaf curl Joydebpur virus-Bangladesh [Bangladesh]	AJ875159		ToLCJoV-BD[BD]
Tomato leaf curl Joydebpur virus-India [India;Kalyani;2006]	EF194765		ToLCJoV-IN[IN:Kal;06]
<i>Tomato leaf curl Karnataka virus</i>			
Tomato leaf curl Karnataka virus-Bangalore [India:Bangalore:1993]	U38239		ToLCKV-Ban[IN:Ban:93]

Table 1 continued

Tomato leaf curl Karnataka virus-Iran [Iran:Iranshahr]	AY297924		ToLCKV-IR[IR:Ira]
Tomato leaf curl Karnataka virus-Janti [India:Janti:2005]	AY754812		ToLCKV- Jan[IN:Jan:05]
<i>Tomato leaf curl Kerala virus</i>			
Tomato leaf curl Kerala virus-[India:Kerala II:2005]	DQ852623		ToLCKeV- [IN:KerII:05]
<i>Tomato leaf curl Laos virus</i>			
Tomato leaf curl Laos virus-[Laos]	AF195782		ToLCLV-[LA]
<i>Tomato leaf curl Madagascar virus</i>			
Tomato leaf curl Madagascar virus-Androy [Madagascar:Toliary:2001]	AJ865339		ToLCMGV- And[MG:Tol:01]
Tomato leaf curl Madagascar virus-Menabe [Madagascar:Morondova:2001]	AJ865338		ToLCMGV- Men[MG:Mor:01]
<i>Tomato leaf curl Malaysia virus</i>			
Tomato leaf curl Malaysia virus-[Malaysia:Klang:1997]	AF327436		ToLCMYV- [MY:Kla:97]
<i>Tomato leaf curl Mayotte virus</i>			
Tomato leaf curl Mayotte virus-[Mayotte:Kahani:2003]	AJ865340		ToLCYTV- [YT:Kah:03]
<i>Tomato leaf curl New Delhi virus</i>			
Tomato leaf curl New Delhi virus-India [Bangladesh:Jessore: Severe:2005]	AJ875157	AJ855158	ToLCNDV- IN[BG:Jes:Svr:05]
Tomato leaf curl New Delhi virus-India [India:Hissar:Cotton:2005]	EF063145		ToLCNDV- IN[IN:His:Cot:05]
Tomato leaf curl New Delhi virus-India [India:Lucknow]	Y16421	X89653	ToLCNDV-IN[IN:Luc]
Tomato leaf curl New Delhi virus-India [India:Meerut:Potato 12:2002]	AY286316	AY158080	ToLCNDV- IN[IN:Mee:Po12:02]
Tomato leaf curl New Delhi virus-India [India:New Delhi:2005]	DQ169056	DQ169057	ToLCNDV- IN[IN:ND:05]
Tomato leaf curl New Delhi virus-India [India:New Delhi:AVT1]	AY428769	AY438563	ToLCNDV- IN[IN:ND:AVT1]
Tomato leaf curl New Delhi virus-India [India:New Delhi:Mild:1992]	U15016		ToLCNDV- IN[IN:ND:Mld:92]
Tomato leaf curl New Delhi virus-India [India:New Delhi:Severe:1992]	U15015	U15017	ToLCNDV- IN[IN:ND:Svr:92]
Tomato leaf curl New Delhi virus-India [India:Sonepat:Luffa:2005]	AY939926	AY939924	ToLCNDV- IN[IN:Son:Luf:05]
Tomato leaf curl New Delhi virus-India [Pakistan:Dargai:T5/6:2001]	AF448058	AY150305	ToLCNDV- IN[PK:Dar:T5/6:01]
Tomato leaf curl New Delhi virus-India [Pakistan:Islamabad:T1/8:2000]	AF448059	AY150304	ToLCNDV- IN[PK:Isl:T1/8:00]
Tomato leaf curl New Delhi virus-India [Pakistan:Khalawal:Chili:2004]	DQ116880	DQ116882	ToLCNDV- IN[PK:Kha:Chi:04]
Tomato leaf curl New Delhi virus-India [Pakistan:Lahore:2004]	AM258977	AM392426	ToLCNDV- IN[PK:Lah:04]
Tomato leaf curl New Delhi virus-India [Pakistan:Multan:Luffa:2004]	AM292302		ToLCNDV- IN[PK:Mul:Luf:04]
Tomato leaf curl New Delhi virus-India [Pakistan:Solanum nigrum:1997]	AJ620187	AJ620188	ToLCNDV- IN[PK:Sn:97]
Tomato leaf curl New Delhi virus-India [Pakistan:Solanum nigrum:2004]	DQ116885		ToLCNDV- IN[PK:Sol:04]
Tomato leaf curl New Delhi virus-India [Pakistan:Solanum nigrum:PT10:2004]	DQ116883		ToLCNDV- IN[PK:Sol:PT10:04]

Table 1 continued

Tomato leaf curl New Delhi virus-India [India:Happur:Potato:2005]	EF043230	EF043233	ToLCNDV-IN[IN:Hap:Pot:05]
Tomato leaf curl New Delhi virus-India [India:Meerut:Potato:2005]	EF043231	EF043232	ToLCNDV-IN[IN:Mer:Pot:05]
Tomato leaf curl New Delhi virus-Papaya [India:New Delhi:Papaya:2005]	DQ989325		ToLCNDV-Pap[IN:ND:Pap:05]
Tomato leaf curl New Delhi virus-Thailand [Thailand:Luffa]	AF102276		ToLCNDV-TH[TH:Luf]
<i>Tomato leaf curl Pakistan virus</i>			
Tomato leaf curl Pakistan virus-[Pakistan:Rahim Yar Khan 1:2004]	AB116884		ToLCPKV-[PK:RYK1:04]
<i>Tomato leaf curl Philippines virus</i>			
Tomato leaf curl Philippines virus-A [Philippines:Los Banos 1:1995]	AF136222		ToLCPV-A[PH:LB1:95]
Tomato leaf curl Philippines virus-B [Philippines:Los Banos 2]	AB050597		ToLCPV-B[PH:LB2]
Tomato leaf curl Philippines virus-C [Philippines:San Leonardo:2005]	DQ092867		ToLCPV-C[PH:SLeo:05]
<i>Tomato leaf curl Pune virus</i>			
Tomato leaf curl Pune virus-[India:Pune:2005]	AY754814		ToLCBV-[IN:Pun:05]
<i>Tomato leaf curl Rajasthan virus</i>			
Tomato leaf curl Rajasthan virus-[India:Rajasthan:2005]	DQ339117		ToLCBV-[IN:Raj:05]
<i>Tomato leaf curl Sinaloa virus</i>			
Tomato leaf curl Sinaloa virus-[Nicaragua:Condega]		AJ508782	ToLCSinV-[NI:Con]
Tomato leaf curl Sinaloa virus-[Nicaragua:Santa Lucia]	AJ608286	AJ508783	ToLCSinV-[NI:SL]
<i>Tomato leaf curl Sri Lanka virus</i>			
Tomato leaf curl Sri Lanka virus-[Sri Lanka:Bandarawela:1997]	AF274349		ToLCSLV-[LK:Ban:97]
<i>Tomato leaf curl Sudan virus</i>			
Tomato leaf curl Sudan virus-Gezira [Sudan:Gezira:1996]	AY044137		ToLCSDV-Gez[SD:Gez:96]
Tomato leaf curl Sudan virus-Shambat [Sudan:Shambat:1996]	AY044139		ToLCSDV-Sha[SD:Sha:96]
Tomato leaf curl Sudan virus-Yemen [Yemen:Tihamah:2006]	EF110890		ToLCSDV-YE[YE:Tih:06]
<i>Tomato leaf curl Taiwan virus</i>			
Tomato leaf curl Taiwan virus-A [Taiwan:Changua1:2005]	DQ866125		ToLCTWV-A[TW:Cha1:05]
Tomato leaf curl Taiwan virus-A [Taiwan:Guangdong:BS:2005]	DQ237918		ToLCTWV-A[CN:Gu:BS:05]
Tomato leaf curl Taiwan virus-A [Taiwan:Hsinchu:C1:2005]	DQ866126		ToLCTWV-A[TW:Hsi:C1:05]
Tomato leaf curl Taiwan virus-A [Taiwan:Hualian:HT7:2005]	DQ866129		ToLCTWV-A[TW:Hua:HT7:05]
Tomato leaf curl Taiwan virus-A [Taiwan:Tainan:FDE2.2:2005]	DQ866122		ToLCTWV-A[TW:Tai:FDE2.2:05]
Tomato leaf curl Taiwan virus-A [Taiwan:Taitung:2005]	DQ866130		ToLCTWV-A[TW:Tai:05]
Tomato leaf curl Taiwan virus-A [Taiwan:Taoyuan1:2005]	DQ866127		ToLCTWV-A[TW:Tao1:05]
Tomato leaf curl Taiwan virus-A [Taiwan]	U88692		ToLCTWV-[TW]
Tomato leaf curl Taiwan virus-B [Taiwan:Hualian:GT6:2005]	DQ866123		ToLCTWV-B[TW:Hua:GT6:05]

Table 1 continued

Tomato leaf curl Taiwan virus-C [Taiwan:Chiayi:LJC14:2005]	DQ866128		ToLCTWV- C[TW:Chi:LJC14:05]
Tomato leaf curl Uganda virus			
Tomato leaf curl Uganda virus-[Uganda:Iganga:2005]	DQ127170		ToLCUV-[UG:Iga:05]
Tomato leaf curl Vietnam virus			
Tomato leaf curl Vietnam virus-[Vietnam:Hanoi:1998]	AF264063		ToLCVV-[VN:Han:98]
Tomato leaf curl Vietnam virus-[Vietnam:Hanoi:2005]	DQ641705		ToLCVV-[VN:Han:05]
Tomato leaf curl virus			
Tomato leaf curl virus-Solanum [Australia:Solanum:D1]	AF084006		ToLCV- Sol[AU:Sol:D1]
Tomato leaf curl virus-Solanum [Australia:Solanum:D2]	AF084007		ToLCV- Sol[AU:Sol:D2]
Tomato leaf curl virus-Tomato [Australia]	S53251		ToLCV-To[AU]
Tomato mild yellow leaf curl Aragua virus			
Tomato mild yellow leaf curl Aragua virus-[Venezuela:10]	AY927277		ToMYLCAV-[VE:10]
Tomato mosaic Havana virus			
Tomato mosaic Havana virus-[Cuba:Quivicán]	Y14874	Y14875	ToMHV-[CU:Qui]
Tomato mottle Taino virus			
Tomato mottle Taino virus-[Cuba]	AF012300	AF012301	ToMoTV-[CU]
Tomato mottle virus			
Tomato mottle virus-[Puerto Rico:2004]	AY965900	AY965901	ToMoV-[PR:04]
Tomato mottle virus-[United States of America:Florida:1989]	L14460	L14461	ToMoV-[US:Flo:89]
Tomato rugose mosaic virus			
Tomato rugose mosaic virus-[Brazil:Uberlandia 1:1996]	AF291705	AF291706	ToRMV-[BR:Ube1:96]
Tomato severe leaf curl virus			
Tomato severe leaf curl virus-Guatemala [Guatemala:Sansirisay:1996]	AF130415		ToSLCV- GT[GT:San:96]
Tomato severe leaf curl virus-Guatemala [Mexico:Rioverde 1:2005]	DQ347946		ToSLCV- GT[MX:Rio1:05]
Tomato severe leaf curl virus-Guatemala [Mexico:Rioverde 2:2005]	DQ347947		ToSLCV- GT[MX:Rio2:05]
Tomato severe leaf curl virus-Nicaragua [Nicaragua:Condega]	AJ508784		ToSLCV-NI[NI:Con]
Tomato severe leaf curl virus-Nicaragua [Nicaragua:Santa Lucia]	AJ508785		ToSLCV-NI[NI:SL]
Tomato severe rugose virus			
Tomato severe rugose virus-[Brazil:Petrópolis de Goiás 1:Pepper:2003]	DQ207749		ToSRV- [BR:PG1:Pep:03]
Tomato severe rugose virus-[Brazil:Uberlandia 2:2000]	AY029750		ToSRV-[BR:Ube1:00]
Tomato yellow leaf curl Axarquia virus			
Tomato yellow leaf curl Axarquia virus- [Spain:Algarrobo:2000]	AY227892		TYLCAxV-[ES:Alg:00]
Tomato yellow leaf curl China virus			
Tomato yellow leaf curl China virus-Baoshan1 [China:Yunnan 10:Tobacco:2000]	AJ319675		TYLCCNV-Bao1 [CN:Yn10:Tob:00]
Tomato yellow leaf curl China virus-Bean [China:Yunnan:Bean:2004]	DQ256460		TYLCCNV- Bea[CN:Yn:Bea:04]
Tomato yellow leaf curl China virus-Chuxiong [China:Yunnan 25:Tomato:2000]	AJ457985		TYLCCNV-Chu [CN:Yn25:Tom:00]
Tomato yellow leaf curl China virus-Chuxiong [China:Yunnan 295:Tobacco:2005]	AM260703		TYLCCNV-Chu [CN:Yn295:Tob:05]

Table 1 continued

Tomato yellow leaf curl China virus-Dali [China:Yunnan 43:Tobacco:2001]	AJ781302		TYLCCNV-Dal [CN:Yn43:Tob:01]
Tomato yellow leaf curl China virus-Dali [China:Yunnan 5:Tobacco:1999]	AJ319674		TYLCCNV-Dal [CN:Yn5:Tob:99]
Tomato yellow leaf curl China virus-Dali [China:Yunnan 8:Tobacco:1999]	AJ319677		TYLCCNV-Dal [CN:Yn8:Tob:99]
Tomato yellow leaf curl China virus-Datura [China:Yunnan 72: Datura:2005]	EF011559		TYLCCNV-Dat [CN:Yn72:05]
Tomato yellow leaf curl China virus-Honghe [China:Guangxi 102:2004]	AM050555		TYLCCNV-Hon [CN:Gx102:04]
Tomato yellow leaf curl China virus-Honghe [China:Guangxi]	AF311734		TYLCCNV-Hon [CN:Gx]
Tomato yellow leaf curl China virus-Honghe [China:Yunnan 231:Tobacco:2005]	AM260701		TYLCCNV-Hon [CN:Yn231:Tob:05]
Tomato yellow leaf curl China virus-Honghe [China:Yunnan 244:Tobacco:2005]	AM260702		TYLCCNV-Hon [CN:Yn244:Tob:05]
Tomato yellow leaf curl China virus-Honghe [China:Yunnan 322:Solanum:2005]	AM181683		TYLCCNV-Hon [CN:Yn322:Sol:05]
Tomato yellow leaf curl China virus-Honghe [China:Yunnan 36:Tobacco:2001]	AJ420316		TYLCCNV-Hon [CN:Yn36:Tob:01]
Tomato yellow leaf curl China virus-Honghe [China:Yunnan 38:Tobacco:2001]	AJ420317		TYLCCNV-Hon [CN:Yn38:Tob:01]
Tomato yellow leaf curl China virus-Honghe [China:Yunnan 64:Siegesbeckia:2001]	AJ457823		TYLCCNV-Hon [CN:Yn64:Sie:01]
Tomato yellow leaf curl China virus-Baoshan2 [China:Yunnan 11:Tobacco:2000]	AJ319676		TYLCCNV-Bao2 [CN:Yn11:Tob:00]
<i>Tomato yellow leaf curl Guangdong virus</i>			
Tomato yellow leaf curl Guangdong virus- [China:Guangzhou 3:2003]	AY602166		TYLCGuV- [CN:Gz3:03]
<i>Tomato yellow leaf curl Indonesia virus</i>			
Tomato yellow leaf curl Indonesia virus- [Indonesia:Lembang:2005]	AF189018		TYLCIDV-[ID:Lem:05]
<i>Tomato yellow leaf curl Kanchanaburi virus</i>			
Tomato yellow leaf curl Kanchanaburi virus- [Thailand:Kanchanaburi 1:2001]	AF511529	AF511528	TYLCKaV- [TH:Kan1:01]
Tomato yellow leaf curl Kanchanaburi virus- [Thailand:Kanchanaburi 2:Eggplant:2001]	AF511530	AF511527	TYLCKaV- [TH:Kan2:Egg:01]
Tomato yellow leaf curl Kanchanaburi virus- [Vietnam:2005]	DQ169054	DQ169055	TYLCKaV-[VN:05]
Tomato yellow leaf curl Kanchanaburi virus- [Vietnam:Binhduong:Eggplant:2005]	DQ641702		TYLCKaV- [VN:Bin:Egg:05]
<i>Tomato yellow leaf curl Malaga virus</i>			
Tomato yellow leaf curl Malaga virus-[Spain:421:1999]	AF271234		TYLCMaV- [ES:421:99]
<i>Tomato yellow leaf curl Mali virus</i>			
Tomato yellow leaf curl Mali virus-Ethiopia [Ethiopia:Mekassa:2005]	DQ358913		TYLCMLV- ET[ET:Mel:05]
Tomato yellow leaf curl Mali virus-Mali [Mali:2003]	AY502934		TYLCMLV- ML[ML:03]
<i>Tomato yellow leaf curl Sardinia virus</i>			
Tomato yellow leaf curl Sardinia virus-Sardinia [Italy:Sardinia:1988]	X61153		TYLCSV-Sar [IT:Sar:88]
Tomato yellow leaf curl Sardinia virus-Sicily [Israel:Rehovot :2005]	DQ845787		TYLCSV-Sic [IL:Reh:05]
Tomato yellow leaf curl Sardinia virus-Sicily [Italy:Sicily]	Z28390		TYLCSV-Sic[IT:Sic]

Table 1 continued

Tomato yellow leaf curl Sardinia virus-Sicily [Tunisia:Bkalta 3:2002]	AY736854		TYLCSV-Sic[TN:Bka3:02]
Tomato yellow leaf curl Sardinia virus-Spain [Morocco:Agadir:2002]	AY702650		TYLCSV-ES[MA:Aga:02]
Tomato yellow leaf curl Sardinia virus-Spain [Spain:Almeria 2:1992]	L27708		TYLCSV-ES[ES:Alm2:92]
Tomato yellow leaf curl Sardinia virus-Spain [Spain:Canary]	AJ519675		TYLCSV-ES[ES:Can]
Tomato yellow leaf curl Sardinia virus-Spain [Spain:Murcia 1:1992]	Z25751		TYLCSV-ES[ES:Mur1:92]
<i>Tomato yellow leaf curl Thailand virus</i>			
Tomato yellow leaf curl Thailand virus-A [Thailand:1]	X63015	X63016	TYLCTHV-A[TH:1]
Tomato yellow leaf curl Thailand virus-A [Thailand:2]	AF141922	AF141897	TYLCTHV-A[TH:2]
Tomato yellow leaf curl Thailand virus-B [China:Yunnan 72:2002]	AJ495812		TYLCTHV-B[CN:Yn72:02]
Tomato yellow leaf curl Thailand virus-B [Myanmar:Yangon:1999]	AF206674		TYLCTHV-B[MM:Yan:99]
Tomato yellow leaf curl Thailand virus-B [Thailand:Chiang Mai]	AY514630	AY514633	TYLCTHV-B[TH:ChMai]
Tomato yellow leaf curl Thailand virus-B [Thailand:Nong Khai]	AY514631	AY514634	TYLCTHV-B[TH:NoK]
Tomato yellow leaf curl Thailand virus-C [Thailand:Sakon Nakhon]	AY514632	AY514635	TYLCTHV-C[TH:SaNa]
<i>Tomato yellow leaf curl Vietnam virus</i>			
Tomato yellow leaf curl Vietnam virus- [Vietnam:Hanoi:2005]	DQ641697		TYLCVNV-[VN:Hano:05]
<i>Tomato yellow leaf curl virus</i>			
Tomato yellow leaf curl virus-Gezira [Sudan:1996]	AY044138		TYLCV-Gez[SD:96]
Tomato yellow leaf curl virus-Iran [Iran:Iranshahr:1998]	AJ132711		TYLCV-IR[IR:Ira:98]
Tomato yellow leaf curl virus-Israel [China:Shanghai 2:2005]	AM282874		TYLCV-IL[CN:SH2:05]
Tomato yellow leaf curl virus-Israel [Cuba]	AJ223505		TYLCV-IL[CU]
Tomato yellow leaf curl virus-Israel [Dominican Republic]	AF024715		TYLCV-IL[DO]
Tomato yellow leaf curl virus-Israel [Egypt:Ismaelia]	AY594174		TYLCV-IL[EG:Ism]
Tomato yellow leaf curl virus-Israel [Egypt:Nobaria:1991]	EF107520		TYLCV-IL[EG:Nob:91]
Tomato yellow leaf curl virus-Israel [Israel:Rehovot:1986]	X15656		TYLCV-IL[IL:Reo:86]
Tomato yellow leaf curl virus-Israel [Italy:Sicily:2004]	DQ144621		TYLCV-IL[IT:Sic:04]
Tomato yellow leaf curl virus-Israel [Japan:Haruno:2005]	AB192966		TYLCV-IL[JR:Hano:05]
Tomato yellow leaf curl virus-Israel [Japan:Misumi:Stellaria]	AB116631		TYLCV-IL[JR:Mis:Ste]
Tomato yellow leaf curl virus-Israel [Japan:Miyazaki]	AB116629		TYLCV-IL[JR:Miy]
Tomato yellow leaf curl virus-Israel [Japan:Omura:Eustoma]	AB116630		TYLCV-IL[JR:Omu:Eus]
Tomato yellow leaf curl virus-Israel [Japan:Omura:Ng]	AB110217		TYLCV-IL[JR:Omu:Ng]
Tomato yellow leaf curl virus-Israel [Japan:Tosa:2005]	AB192965		TYLCV-IL[JR:Tos:05]
Tomato yellow leaf curl virus-Israel [Jordan:Tomato:2005]	EF054893		TYLCV-IL[JO:Tom:05]
Tomato yellow leaf curl virus-Israel [Lebanon:Tomato:2005]	EF051116		TYLCV-IL[LB:Tom:05]
Tomato yellow leaf curl virus-Israel [Mexico:Culiacan:2005]	DQ631892		TYLCV-IL[MX:Cul:05]
Tomato yellow leaf curl virus-Israel [Morocco:Berkane:2005]	EF060196		TYLCV-IL[MO:Ber:05]

Table 1 continued

Tomato yellow leaf curl virus-Israel [Puerto Rico:2001]	AY134494		TYLCV-IL[PR:01]
Tomato yellow leaf curl virus-Israel [Spain:Almeria:Pepper:1999]	AJ489258		TYLCV-IL[ES:Alm:Pep:99]
Tomato yellow leaf curl virus-Israel [Tunisia:2005]	EF101929		TYLCV-IL[TN:05]
Tomato yellow leaf curl virus-Israel [Turkey:Mersin:2005]	AJ812277		TYLCV-IL[TR:Mer:05]
Tomato yellow leaf curl virus-Israel [United States:Florida:1997]	AY530931		TYLCV-IL[US:Flo]
Tomato yellow leaf curl virus-Mild [Israel:1993]	X76319		TYLCV-Mld[IL:93]
Tomato yellow leaf curl virus-Mild [Japan:Aichi]	AB014347		TYLCV-Mld[JR:Aic]
Tomato yellow leaf curl virus-Mild [Japan:Aichi2:2003]	DD033365		TYLCV-Mld[JR:Aic2:03]
Tomato yellow leaf curl virus-Mild [Japan:Atumi]	AB116633		TYLCV-Mld[JR:Atu]
Tomato yellow leaf curl virus-Mild [Japan:Daito]	AB116635		TYLCV-Mld[JR:Dai]
Tomato yellow leaf curl virus-Mild [Japan:Kisozaki]	AB116634		TYLCV-Mld[JR:Kis]
Tomato yellow leaf curl virus-Mild [Japan:Osuka]	AB116636		TYLCV-Mld[JR:Osu]
Tomato yellow leaf curl virus-Mild [Japan:Shimizu]	AB110218		TYLCV-Mld[JR:Shi]
Tomato yellow leaf curl virus-Mild [Japan:Shizuoka]	AB014346		TYLCV-Mld[JR:Shz]
Tomato yellow leaf curl virus-Mild [Japan:Yaizu]	AB116632		TYLCV-Mld[JR:Yai]
Tomato yellow leaf curl virus-Mild [Jordan:Cucumber:2005]	EF158044		TYLCV-Mld[JO:Cuc:05]
Tomato yellow leaf curl virus-Mild [Jordan:Homra:2003]	AY594175		TYLCV-Mld[JO:Hom:03]
Tomato yellow leaf curl virus-Mild [Jordan:Tomato:2005]	EF054894		TYLCV-Mld[JO:Tom:05]
Tomato yellow leaf curl virus-Mild [Lebanon:LBA44:05]	EF185318		TYLCV-Mld[ILB:LBA44:05]
Tomato yellow leaf curl virus-Mild [Portugal:2:1995]	AF105975		TYLCV-Mld[PT:2:95]
Tomato yellow leaf curl virus-Mild [Reunion:2002]	AJ865337		TYLCV-Mld[RE:02]
Tomato yellow leaf curl virus-Mild [Spain:72:1997]	AF071228		TYLCV-Mld[ES:72:97]
Tomato yellow leaf curl virus-Mild [Spain:Almeria:1999]	AJ519441		TYLCV-Mld[ES:Alm:99]
Tomato yellow leaf curl virus-Oman [Oman:Al-Batinah:2005]	DQ644565		TYLCV-OM[OM:Alb:05]
<i>Tomato yellow margin leaf curl virus</i>			
Tomato yellow margin leaf curl virus-[Venezuela:Merida 57]	AY508993	AY508994	TYMLCV-[VE:Mer57]
<i>Tomato yellow spot virus</i>			
Tomato yellow spot virus-[Brazil:Bicas 2:1999]	DQ336350	DQ336351	ToYSV-[BR:Bic2:99]
<i>Vernonia yellow vein virus</i>			
Vernonia yellow vein virus-[India:Madurai:2005]	AM182232		VeYVV-[IN:Mad:05]
<i>Watermelon chlorotic stunt virus</i>			
Watermelon chlorotic stunt virus-[Iran:1997]	AJ245652	AJ245653	WmCSV-[IR:97]
Watermelon chlorotic stunt virus-[Sudan]	AJ245650	AJ245651	WmCSV-[SD]
Watermelon chlorotic stunt virus-[Yemen]	AJ012081	AJ012082	WmCSV-[YE]
UNASSIGNED ISOLATES IN THE GENUS			
<i>Acalypha yellow mosaic virus</i>			AYMV
<i>Asystasia golden mosaic virus</i>			AGMV
<i>Bean mosaic Florida virus</i>			BMFIV
<i>Bitter gourd yellow blotch virus</i>			BGYBV
<i>Calendulla yellow net virus</i>			CYNV
<i>Calopogonium golden mosaic virus</i>			CaGMV
<i>Clerodendron yellow mosaic virus</i>			CIYMV

Table 1 continued

<i>Clitoria falcata mosaic virus</i>		CIFMV
<i>Cotton leaf crumple virus</i>		CLCrV
<i>Cotton yellow mosaic virus</i>	AF076852	CotYMV
<i>Cucurbita maxima yellow mosaic virus</i>		CuMYMV
<i>Eclipta yellow vein virus</i>		EYVV
<i>Euphorbia mosaic virus</i>		EuMV
<i>Eggplant yellow mosaic virus</i>		EYMV
<i>Guar mosaic virus</i>		GMV
<i>Hibiscus rosa-sinensis mosaic virus</i>		HRSMV
<i>Jatropha mosaic virus</i>		JMV
<i>Kenal mosaic virus</i>		KMV
<i>Leonurus mosaic virus</i> -[Brazil:Dourados 1:1992]	U92532	LeMV-[BR:Dou1:92]
<i>Lupin leaf curl virus</i>		LLCuV
<i>Macroptilium golden mosaic virus</i> -[Jamaica:1]	AF098940	MGMV-[JM:1]
<i>Macroptilium golden mosaic virus</i> -[Jamaica:2]	AF098939	MGMV-[JM:2]
<i>Macroptilium golden mosaic virus</i> -[PR]	AF176092-4	MGMV-[PR]
<i>Macroptilium mosaic virus</i>		MMV
<i>Macrotyloma mosaic virus</i>		MaMV
<i>Malvaceous chlorosis virus</i>		MCV
<i>Melon chlorotic mosaic virus</i>		MCMV
<i>Melon leaf curl virus</i>		MLCuV
<i>Okra leaf curl India virus</i> (Okra leaf curl virus-India)		OkLCuIV
<i>Okra leaf curl virus</i> (Okra leaf curl virus-[Côte D'Ivoire])		OkLCuV
<i>Okra mosaic Mexico virus</i>	AF076854	OkMMV
<i>Okra yellow mottle Iguala virus</i>		OkYMoIV
<i>Okra yellow mottle virus</i>		OkYMoV
<i>Passion flower little leaf mosaic virus</i> -[Brazil:Livramento 1:2001]	AY167566	PFLLMV-[BR:Liv1:01]
<i>Passion flower little leaf mosaic virus</i> ,		PFLLMV
<i>Pepper mild tigré virus</i>		PepMTV
<i>Pepper rizado amarillo virus</i>		PepRAV
<i>Pepper yellow leaf curl Indonesia virus</i>		PepYLCuIV
<i>Pepper yellow vein virus</i>		PepYVV
<i>Pigeon pea mosaic virus</i>		PPMV
<i>Pigeon pea yellow mosaic virus</i>		PPYMV
<i>Potato yellow mosaic virus</i> -[Tomato]	AF026553	PYMV-[To]
<i>Pseuderanthemum yellow vein virus</i>		PYVV
<i>Pumpkin yellow vein mosaic virus</i>	AY184488	PuYVMV
<i>Rhynchosia minima Trinidad virus</i>		RhMTV
<i>Rhynchosia mosaic virus</i>		RhMV
<i>Sida golden mosaic Jamaica virus</i>	U67926, U69601, U68177	SiGMJV
<i>Sida golden mosaic Jamaica virus</i> -[3]	U69157-8, U69602	SiGMJV-[3]
<i>Sida golden mosaic Jamaica virus</i> -[Macroptilium 19]	U69159, U70386	SiGMJV-[Mac19]
<i>Sida rhombifolia Trinidad virus</i>		SiRTV
<i>Solanum apical leaf curl virus</i>		SALCV
<i>Solanum yellow leaf curl virus</i>		SYLCV
<i>Squash leaf curl Chinese virus</i>		
<i>Squash leaf curl Israel virus</i>		SYLCIV
<i>Squash yellow mottle virus</i>		SYMov

Table 1 continued

<i>Tobacco apical stunt virus</i> -[Mexico:Chiapas:1991]	AF077744, AF077746, AF076855	TbASV-[MX:Chi:91]
<i>Tobacco leaf curl India virus</i> (Tobacco leaf curl virus-India)	AB001292-8	TbLCIV
	AB001301-4	
	AB001307-20	
<i>Tobacco leaf rugose virus</i> -[Cuba]	AJ488768	TbLRV-[CU]
<i>Tomato chlorotic vein virus</i> -[Brazil:Brasilia 1:1994]	AY049205	ToClVV-[BR:Br1:94]
<i>Tomato crinkle yellow leaf virus</i> -[Brazil:Vicos 3:1999]	AY090556	ToCYLV-[BR:Vic3:99]
<i>Tomato crinkle virus</i> -[Brazil:Pesqueira 3:1998]	AY049218	ToCrV-[BR:Pes3:98]
<i>Tomato dwarf leaf curl virus</i>	AF035224-5	ToDLCV
<i>Tomato golden vein virus</i> -[Brazil:Anapolis 1:2003]	AY751742	ToGVV-[BR:Ana1:03]
<i>Tomato infectious yellows virus</i> -[Brazil:Bicas 1:1999]	AY049208	ToIYV-[BR:Bic1:99]
<i>Tomato leaf curl India virus</i>	L11746	ToLCIV
<i>Tomato leaf curl Indonesia virus</i>	AF189018	ToLCIDV
<i>Tomato leaf curl Nicaragua virus</i>	AJ277057-61	ToLCNV
<i>Tomato leaf curl Senegal virus</i> (Tomato leaf curl virus-Senegal)	D88800, AF058028	ToLCSV
<i>Tomato leaf curl Tanzania virus</i> (Tomato leaf curl virus-Tanzania)	U73498	ToLCTZV
<i>Tomato mild yellow mottle virus</i> -[Honduras:H5kw:1996]	AF131071	ToMYMoV-[HN:H5kw:96]
<i>Tomato mottle leaf curl virus</i> -[Brazil:Mossoro 1:1999]	AY049227	ToMoLCV-[BR:Mos1:99]
<i>Tomato mosaic Barbados virus</i>	AF213013-4	ToMBV
<i>Tomato severe leaf curl virus</i> -[Guatemala:Sansirisay:Cucumber:1997]	AF131735	ToSLCV-[GT:San:Cu:97]
<i>Tomato severe mosaic virus</i> -[Brazil:Igarapé2:1999]	AY049207	ToSMV-[BR:Iga2:99]
<i>Tomato yellow dwarf virus</i>	U82829	ToYDV
<i>Tomato yellow leaf curl Nigeria virus</i> (Tomato yellow leaf curl virus-Nigeria)		TYLCNV
<i>Tomato yellow leaf curl Kuwait virus</i>	AF065822	TYLCKWV
<i>Tomato yellow leaf curl Saudi Arabia virus</i> (Tomato yellow leaf curl virus-Saudi Arabia) (Tomato yellow leaf curl virus-Southern Saudi Arabia)		TYLCSAV
<i>Tomato yellow leaf curl Tanzania virus</i> (Tomato yellow leaf curl virus-Tanzania)	U73498	TYLCTZV
<i>Tomato yellow leaf curl Yemen virus</i> (Tomato yellow leaf curl virus-Yemen)	X79429	TYLCYV
<i>Tomato yellow mosaic virus</i>		ToYMV
Tomato yellow mosaic virus-[Brazil:1]		ToYMV-[BZ:1]
Tomato yellow mosaic virus-[Brazil:2]		ToYMV-[BZ:2]
<i>Tomato yellow mottle virus</i>	AF112981	ToYMoV
<i>Tomato yellow vein streak virus</i> -[Brazil:Campinas2:1995]	U79998, U80042	ToYVSV-[BR:Cam2:95]
<i>Tomato yellow vein streak virus</i> (Tomato yellow vein streak virus-Brazil)	U79998, U80042	ToYVSV
<i>Watermelon curly mottle virus</i>		WmCMV
<i>Wissadula golden mosaic virus</i> -[Jamaica:1]	U692801, U696034, U697323	WGMV-[JM:1]
<i>Zinnia leaf curl virus</i>		ZiLCV

LIST OF UNASSIGNED VIRUSES IN THE FAMILY

Table 1 continued

None reported

The species are written in *italics* and in **bold**. The *first column* indicates species and virus isolate name. The second column refers to *A* component sequence accession numbers and the third column refers to *B* component sequence accession numbers. The fourth column indicates the *abbreviation* of the isolate virus name.

List of isolates that could be promoted to strain status

It is apparent that a stable genetic change in a virus leading to a distinctive phenotype can be as small as an alteration to a single nucleotide. However, our statistical analysis indicates a peak corresponding to approximately 90–91% identity, representing about 300 nucleotide changes between genome (genomic component) sequences for these isolates. Because most of the recognized begomovirus strains cluster within the peak, we propose to define all such isolates as strains. On this basis, reviewing geminivirus information compiled in sequence databases and the last update of geminivirus isolates that we have done [5], the following begomoviruses would gain the status of strain:

<i>Begomovirus</i>	<i>Accession number</i>
AYVV	X74516
AYVV-[Tom]	AB100305
BYVMV-[Mad]	AF241479
BYVMV-[301]	AJ002453
CLCuGV-[HI/Cai]	AJ542539
EACMV-[TZ]	Z83256
EACMV-[KEK2B]	AJ006458
EpYVV-[MNS2]	AJ438936
EpYVV-[Yam]	AB079766
HYVMV-[Yam]	AB079765
HYVV-[SP1]	AB182261
MCLCuV-[GT]	AF325497
MCLCuV-[CR]	AY064391
PaLCuCNV-[G10]	AJ558125
PaLCuV-[Cot]	AJ436992
PaLCuV	Y15934
PepGMV-[Tam]	U57457
PepGMV-[CR]	AF149227
PepGMV-[Di]	AY928512
PepGMV-[Mo]	AY928516
PepGMV-[Ser]	AY928514
SiMoV-[BR]	AY090555
SiMoV-[A1B3]	AJ557450
ToChLPV-[BCS]	AY339619
ToLCBV	Z48182
ToLCJV	AB100304
ToLCJV-[Age]	AB162141
ToLCV-[AU]	S53251
ToSLCV-[NI1]	AJ508784
ToSLCV-[NI2]	AJ508785
TYLCCNV-[Y43]	AJ781302
TYLCTHV-[SaNa]	AY514632

The following viruses probably should be grouped within the mild strain of TYLCV on the basis of the phenotype of the virus that originally described that cluster:

<i>Abbreviation</i>	<i>Accession number</i>	<i>New abbreviation</i>
TYLCV-[Atu]	AB116633	TYLCV-Mld[Atu]
TYLCV-[Kis]	AB116634	TYLCV-Mld[Kis]
TYLCV-[SzD]	AB116635	TYLCV-Mld[SzD]
TYLCV-[SzOs]	AB116636	TYLCV-Mld[SzOs]
TYLCV-[SzY]	AB116632	TYLCV-Mld[AzY]
TYLCV-[Sz]	AB110218	TYLCV-Mld[Sz]

The following two pairs of viruses have pairwise sequence identities of about 91% with other isolates of the same virus species, and therefore one member of the pair deserves the status of strain:

<i>First virus</i>	<i>Accession number</i>	<i>Second virus</i>	<i>Accession number</i>
ToLCSDV-[Gez]	AY044137	ToLCSDV-[Sha]	AY044139
TYLCSV-[Sic]	Z28390	TYLCSV-[Tun]	AY736854

Based on the pairwise sequence comparison score, the following four isolates require a strain descriptor:

<i>Begomovirus</i>	<i>Accession number</i>
TYLCSV-[ES2]	L27708
TYLCSV-[U83-8]	AJ519675
TYLCSV-[ES1]	Z25751
TYLCSV-[MA]	AY702650

Using the same criteria, a single curtovirus could be considered a strain:

<i>Curtovirus</i>	<i>Accession number</i>
BCTV-Cal[Log]	AF379637

This virus already has a strain descriptor in the published list (BCTV-Cal[Log]) along with BCTV-Cal. They were both originally assigned as California strains before other curtovirus species were recognized and have retained this unnecessary strain descriptor since then. Hence, the viruses should be referred to as BCTV-[Cal] and BCTV-Log[Cal].

Examples of nomenclature for descriptors under the species level

Virus names should adopt the nomenclature structure:

Species name, strain descriptor (symptoms, host, location, if appropriate or a letter such as A, B, C) [**variant descriptor** (country: location: [host]: year)]

The following case studies are used to illustrate name derivation:

<i>Species/virus name</i>	<i>Abbreviation</i>
<i>East African cassava mosaic virus</i>	
East African cassava mosaic virus, Tanzania [Tanzania:Yellow vein]	EACMV-TZ[TZ:YV]
East African cassava mosaic virus, Kenya [Uganda:1997]	EACMV-KE[UG:97]
East African cassava mosaic virus, Uganda [Tanzania:10]	EACMV-UG[TZ:10]
East African cassava mosaic virus, Uganda [Uganda:Severe2:1997]	EACMV-UG[UG:Sev2:97]
East African cassava mosaic virus, Uganda [Kenya:Wote:K282:2002]	EACMV-UG[KE:Wot:K282:02]

The original virus isolate for the strain that induces very severe symptoms on cassava was found in Uganda, hence the descriptor “Uganda”. This was the second EACMV isolate from Uganda, hence the use of [Severe 2] as variant descriptor. Because recombination within the capsid protein sequence is associated with this phenotype, “Uganda Severe” becomes a label for this genotype. The severe strains found in Kenya and Tanzania were the first to be described in these countries. Because it is highly likely that many more isolates will be described in the future, it is advisable to use a more

specific location rather than the country name to distinguish variants, such as “Wote” in the example above.

<i>Species/virus name</i>	<i>Abbreviation</i>
<i>Mungbean yellow mosaic Indian virus</i>	
Mungbean yellow mosaic India virus [India:Varanasi:Dolichos]	MYMIV-[IN:Var:Dol]
Mungbean yellow mosaic India virus [Nepal:Lalitpur]	MYMIV-[NP:Lal]
Mungbean yellow mosaic India virus [Pakistan:106]	MYMIV-[PK:106]
Mungbean yellow mosaic India virus [Pakistan:130.12]	MYMIV-[PK:130.12]
Mungbean yellow mosaic India virus [Pakistan:130.7]	MYMIV-[PK:130.7]
Mungbean yellow mosaic India virus [Pakistan:14]	MYMIV-[PK:14]
Mungbean yellow mosaic India virus [Pakistan:Cowpea:2000]	MYMIV-[PK:Cp:00]
Mungbean yellow mosaic India virus [Pakistan:Islamabad:2000]	MYMIV-[PK:Isl:00]

As all of these MYMIV isolates exhibit approximately 95% identity, they should be considered variants of the same species, and consequently there is no need for a strain descriptor. Some of them originate from a different host than the original isolate, and induce very severe and recognizable symptoms in this host, hence the descriptor “Cowpea” and “Dolichos” for these isolates. They have been found in different places in Pakistan, Nepal and India; hence the host name has been qualified by the inclusion of country of origin to provide useful information, and an arbitrary distinguishing sample number has been added in some cases (130.12, 130.7, 14, etc.).

TYLCV was originally isolated in Israel, therefore the variant descriptor should be “Israel” or a more precise location. Because the other isolates listed here cluster with the so-called mild isolate (TYLCV-Mld[IL]) that also originated from Israel, they could adopt the “Mild” strain descriptor. Many of these isolates are from Japan and were distinguished either by a single location or by providing two locations when more than one isolate originated from the same district. This is commendable, and should set a precedent for naming TYLCV variants from Spain and Portugal.

Species/virus name	Abbreviation
<i>Tomato yellow leaf curl virus</i>	
Tomato yellow leaf curl virus, Israel [Israel:Rehovot:1986]	TYLCV-IL[IL:Reo:86]
Tomato yellow leaf curl virus, Israel [Italy:Sicily:2004]	TYLCV-IL[IT:Sic:04]
Tomato yellow leaf curl virus, Israel [Japan:Haruno:2005]	TYLCV-IL[JR:Hano:05]
Tomato yellow leaf curl virus, Israel [Japan:Misumi:Stellaria]	TYLCV-IL[JR:Mis:Ste]
Tomato yellow leaf curl virus, Mild [Israel:1993]	TYLCV-Mild[IL:93]
Tomato yellow leaf curl virus, Mild [Japan:Yaizu]	TYLCV-Mild[JR:Yai]
Tomato yellow leaf curl virus, Mild [Jordan:Cucumber:2005]	TYLCV-Mild[JO:Cuc:05]
Tomato yellow leaf curl virus, Mild [Jordan:Homra:2003]	TYLCV-Mild[JO:Hom:03]
Tomato yellow leaf curl virus, Mild [Jordan:Tomato:2005]	TYLCV-Mild[JO:Tom:05]
Tomato yellow leaf curl virus, Mild [Lebanon:LBA44:2005]	TYLCV-Mild[LB:LBA44:05]
Tomato yellow leaf curl virus, Mild [Portugal:2:1995]	TYLCV-Mild[PT:2:95]
Tomato yellow leaf curl virus, Mild [Reunion:2002]	TYLCV-Mild[RE:02]
Tomato yellow leaf curl virus, Mild [Spain:72:1997]	TYLCV-Mild[ES:72:97]
Tomato yellow leaf curl virus, Mild [Spain:Almeria:1999]	TYLCV-Mild[ES:Alm:99]

Future sample denomination

At the current rate of begomovirus isolation and determination of their complete genomic sequences (230 new isolates appeared during the year starting December 2005), we can predict the addition of hundreds of new virus isolates to the present list in the coming years. As a consequence, there is a growing need to establish a standardized and informative set of isolate descriptors. One possibility is to associate a sample with four descriptors: the original host, the original symptoms, the date of sampling and the GPS coordinates of the plant from which the sample was taken. With this basic information, one can precisely position the virus sample in space and time, and isolates could be mapped automatically. The date of the original sample is important for evolutionary and epidemiological purposes, and so far this is not recorded in sequence databases. Geographic Information Systems (GIS) is now routinely used for automated mapping, and many scientists have embraced this technology. Virologists should be encouraged to do the same, and both of these descriptors will eventually be adopted by NCBI and the other databases.

Conclusion

Virus taxonomy and nomenclature are scientific tools created by scientists to simplify the work of describing and discussing biological entities like viruses. One must not forget that these tools do not exist in nature, and scientists have developed them in the knowledge that they are the best descriptive tools available at any one time. During the past five years, virologists have improved immensely both the taxonomy and the nomenclature for geminiviruses. This is attested by the fact that similar abbreviations of names are largely clustered in the same groups of isolates in a phylogenetic tree built from complete sequences of their genomic components. From a total of 672 isolates, only two clusters show some slight overlap between the 200 demarcated species (TYLCV and HYVMV), a phenomenon that is readily explained by the presence of large recombinant fragments within the genomic components. This is a remarkable correlation in view of the huge number of recombination events that have apparently occurred between many geminiviruses. However, to progress further and cope with a steadily increasing number of virus isolates, we need to derive simple guidelines to enable a more uniform, coherent and informative set of descriptors to be established for strains and variants of geminiviruses. This will complement data of phylogenetic trees and distributions of percentages of pairwise comparisons based on full-length genomic sequences that remain excellent tools for strain and variant demarcation.

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