Virus Name: Fort Morgan	Abbreviation: FMV

Status
Arbovirus

Select Agent
No

SALS Level
2

SALS Basis
Results of SALS surveys and information from the Catalogue.

Other Information

Antigenic Group
A

SECTION I - Full Virus Name and Prototype Number

Prototype Strain Number / Designation
73V4009

Accession Number

Original Date Submitted
10/1/1984

Family
Togaviridae

Genus
Alphavirus

Information From
D.B. Francy

Address
Vector-Borne Diseases Division, Center for Disease Control, Fort Collins, Colorado

Information Footnote
Reviewed by editor

Section II - Original Source

Isolated By (name)
Vector-Borne Diseases Division (1)

Isolated at Institute
CDC, Fort Collins, Colorado

Host Genus
Oeciacus vicarius Horvath (Hemiptera: Cimicidae), pool of 25

Species

Host Age/Stage
Adult

Sex
Not Answered

Isolated From

Isolation Details

Signs and Symptoms of Illness

Arthropod
Depleted

Time Held Alive before Inoculation
2 weeks at 22 +- 2dC

Collection Method
Hand collection from cliff swallow nests

Collection Date
9/26/1973

Place Collected (Minimum of City, State, Country)
Bijou Bridge, Morgan County, Colorado

Latitude
40° 16' N

Longitude
103° 45' W

Macrohabitat
Concrete bridge over cottonwood-lined stream in irrigated farmland, S. Platte River Basin

Microhabitat
Nest of cliff swallow occupied by house sparrows

Method of Storage until Inoculated
Held with nest material in plastic sack at room temperature.

Footnotes

Section III - Method of Isolation

Inoculation Date
9/1/1973

Animal (Details will be in Section 6)
(Tissue Culture)

Route Inoculated

Reisolation

Other Reasons
Different from all other alphaviruses in laboratory by serologic and physicochemical tests

Homologous Antibody Formation by Source Animal

Test(s) Used

Footnotes

Section IV - Virus Properties

Physicochemical
RNA, Single Strand

Pieces (number of genome segments)	Infectivity	Sedimentation Coefficients(s) (S)
Percentage wt, of Virion Protein	Lipid	Carbohydrate
Virion Polypeptides: Number **3 (2)**	Details **E1 glycoprotein, MW 58,000, pI 7.8; E2 glycoprotein, MW 47,000, pI 9.2; C (nucleocapsid), MW 30,000**	
Non-virion Polypeptides: Number	Details	
Virion Density	Sedimentation Coefficients(s) (S)	
Nucleocapsid Density	Sedimentation Coefficients(s) (S)	

Stability of Infectivity (effects)

pH (infective range)
2.0-4.0 inactivates 5.0 dex Vero PFU infectivity

Lipid Solvent (ether - % used to test)	After Treatment Titer	Control Titer
Lipid Solvent (chloroform)	After Treatment Titer	Control Titer
Lipid Solvent (deoxycholate) **1:1000**	After Treatment Titer **<2.0 dex**	Control Titer **5.4 dex**

Other (formalin, radiation)

Virion Morphology

Shape **Spherical**	Dimensions	
Mean nm	Range **55-60 nm**nm	
Measurement Method **Thin-section electron microscopy (3)**	Surface Projections/Envelope **Spikes**	Nucleocapsid Dimensions, Symmetry

Thin-Section Electron Microscopy (5) | Spikes | Symmetry: **Isometric**

Morphogenesis

Site of Constituent Formation in Cell	Site of Virion Assembly	Site of Virion Accumulation
Cytoplasm (nucleocapsids accumulate in nucleus late in infection)	**Cytoplasmic and plasma membranes**	**Extracellular**

Inclusion Bodies

Other

Hemagglutination

Hemaggiutination	Antigen Source	Erythrocytes (species used)
Yes	**Primary duck embryo, Vero cells, SMB**	**Goose**

pH Range	pH Optimum
5.9-6.4	**6.0**

Temperature Range	Temperature Optimum
	37dC

Remarks

Serologic Methods Recommended
HI, CF, NT

Footnotes

Section V - Antigenic Relationship and Lack of Relationship to Other Viruses

Antigen or Antibody of Indicated Virus	Fort Morgan Antigen*			Fort Morgan Antibody*		
	HI	CF	NT	HI	CF	NT
Fort Morgan	40	256	320	40	256	320
WEE (Fleming)	320/320	128/>1024	-/640	10/40	128/256	-/320
Y62-33	320/640	128/512	80/640	-/40	128/256	-/320
HJ	20/80	8/64	-/320	10/40	32/256	-/320
Sindbis	320/640	128/512	-/160	-/40	64/256	-/320
Whataroa	20/	-/32	-/160	ND	-/256	-/320
Aura	20/80	-/64	20/160	-/40	-/256	-/320
Chikungunya	40/160	-/256	-/>640	-/40	-/256	-/320
Mayaro	-/40	-/32	-/160	-/40	-/256	-/320
Semliki Forest	-/640	-/64	-/>640	-/40	-/256	-/320

Una	-/	-/16	-/40	ND	-/256	-/320
O'nyong nyong	-/40	-/32	-/160	-/40	-/256	-/320
Middelburg	-/	-/16	-/320	ND	-/256	-/320
EEE	-/80	-/128	-/>640	-/40	-/256	-/320
VEE IA	-/160	8/128	-/>640	-/40	-/256	-/320
IB	-/80	-/64	-/320	-/40	-/256	-/320
IC	-/640	-/64	-/>640	-/40	-/256	-/320
ID	40/80	16/128	-/160	-/40	-/256	-/320
IE	-/80	-/64	-/160	-/40	-/256	-/320
II	-/640	-/256	-/>640	-/40	64/256	-/320
III	-/160	-/32	-/160	-/40	-/256	-/320
IV	-/>640	-/256	20/160	-/40	-/256	-/320
Bijou Bridge (CM4-146)	10/640	-/64	-/640	-/40	-/256	-/320

* Ht/Ho; - = <10 HI, NT; <8 CF

Section VI - Biologic Characteristics

Virus Source (all VERTEBRATE isolates)
Serum (LV), brain (LV)

Lab Methods of Virus Recovery (ALL ISOLATIONS)
Plaque formation in primary duck embryo or Vero cell cultures; ic inoculation of newborn mice unsatisfactory for primary isolation

Cell system (a)	Virus passage history (b)	Evidence of Infection							
		CPE			PLAQUES			Growth Without CPE	
		Day (c)	Extent (d)	Titer TCD50/ml (e)	Day (c)	Size (f)	Titer PFU/ml (e)	+/- (g)	
Duck embryo (PC)	unpass.	2-3	4+		2-3	2-4 mm			
	DE 1 Vero 1, Vero 5						5.7**		
Vero (CL)		2-3	4+		2-3	2-4 mm	7.8		
Aedes albopictus(CL)								+ -	
L929 (CL)						No plaques	<2.0		

** Expressed in dex

Section VII - Natural Host Range (Additional text can be added below table)

Vertebrate (species and organ) and arthropod	No. isolations/No. tested	No. with antibody/No. tested Test used	Country and region
Oeciacus vicarius	154/28,453 (1,201 pools)		NE Colorado, USA
Oeciacus vicarius	6/880 (18 pools)		South Dakota (Bon Home Co.), USA
Oeciacus vicarius	1/8,068 (100 pools)		West Texas, USA
Oeciacus vicarius	2/590 (14 pools)		Washington (Bent Co.), USA
P. pyrrhonota nestling (serum/brain)	14/291		NE Colorado, USA
P. pyrrhonota adult		43/296 NT	
P. domesticus nestling (serum/brain)	127/1,171		
P. domesticus adult		64/312 NT	
Dipodomys ordii		3/64 NT	
Peromyscus maniculatus		1/41 NT	
Perognathus flavus		0/7 NT	
Mus musculus		0/4 NT	
Sylvilagus sp.		0/7 NT	

Section VIII - Susceptibility to Experimental Infection (include viremia)

Experimental host and age	Passage history and strain	Inoculation Route-Dose	Evidence of infection	AST (days)	Titer log10/ml
Mice (nb)	Unpass.; Vero 1, or Vero 5	ic	Viral growth in CNS, other tissues *		
Mice (nb)		ip	Viral growth in CNS, other tissues *		
Mice (nb)		sc			
Mice (wn)		ic	Antibody		
Mice (wn)		ip	Antibody		
hamsters (nb)		ic	Death	4.0	7.1
hamsters (nb)		ip	Death	4.0	6.4
hamsters (wn)		ic	Paralysis, scattered deaths		
hamsters (wn)		ip	Antibody, paralysis, occasional death		
Passer domesticus					
nestling		sc	Viremia, occasional death (5)		
adult		sc	Viremia		
Petrochelidon					
pyrrhonota: nestling		sc	Viremia		
pyrrhonota: adult		sc	Viremia		

* and variable mortality: 5-10% for unpassaged, 20-80% for Vero 5 passaged virus at all dilutions 5-7 days after inoculation.

Section IX - Experimental Arthropod Infection and Transmission

Arthropod species & virus source(a)	Method of Infection log10/ml (b)		Incubation period (c)		Transmision by bite (d)		Assay of arthropod, log10/ml (e)		
	Feeding	Injected	Days	°C	Host	Ratio	Whole	Organ	System

O. vicarius bugs fed on suspensions of Fort Morgan virus containing 4.5-6.9 logs were shown to contain virus after up to 312 days. Infected bugs transmitted the virus after 33 and 47 days incubation to nestling sparrows. Infection and transmission was demonstrated after 234 and 312 days incubation in bugs held at temperatures simulating hibernation.

Culex tarsalis and Cx pipiens pipiens fed on virus (suspensions and viremic hosts) and held for 9-23 days at 22-24C contained no detectable virus. Minimal levels (1-1.3 dex PFU/ml) were detected in a small proportion of the mosquitoes after intrathoracic inoculation of virus.

Culiseta melanura and Cs inornata did not become infected after oral feeding (pledget suspensions, 6.3 dex/ml) but following intrathoracic inoculation apparent replication to higher levels than in Culex mosquitoes was observed.

Section X - Histopathology

Character of lesions (specify host)
Inflammation, necrosis in brain, spinal cord, skeletal muscle of infected infant mice.

Inclusion Bodies — Intranuclear

Organs/Tissues Affected
Brain and cord: lymphocytic perivascular cuffing, endothelial cell swelling, diffuse gliosis, focal necrosis, neuronal degeneration Striated muscle: degeneration and and necorsis of myofibers, calcification.

Category of tropism
Neuromuscular

Section XI - Human Disease

In Nature	Residual	Death
Subclinical	Overt Disease	
Clinical Manifestations		
Number of Cases	Category (i.e. febrile illness, etc.)	

Section XII - Geographic Distribution

Known (Virus detected)
Colorado; South Dakota; Texas; Washington, U.S.A.

Suspected (Antibody only detected)

Section XIII - References

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Remarks