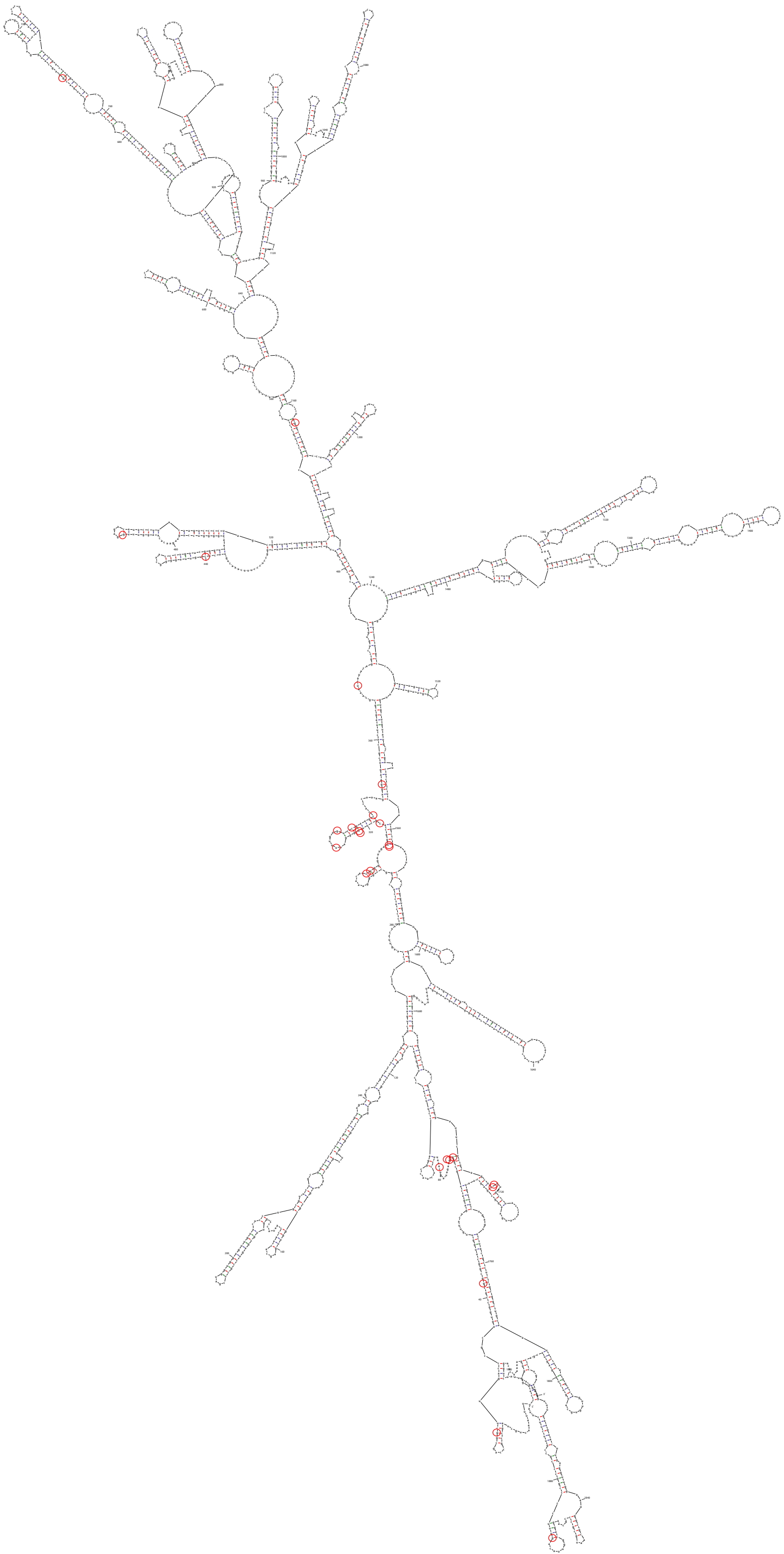


$dG = -630.68$ [Initially -700.00] JXA1 NSP9



$dG = -516.49$ [Initially -585.20] JXA1 ORF2-ORF4



$dG = -629.06$ [Initially -707.50] NADC30 NSP9

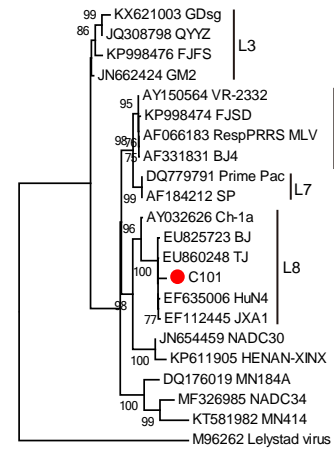


$dG = -543.50$ [Initially -587.00] NADC30 ORF2-ORF4

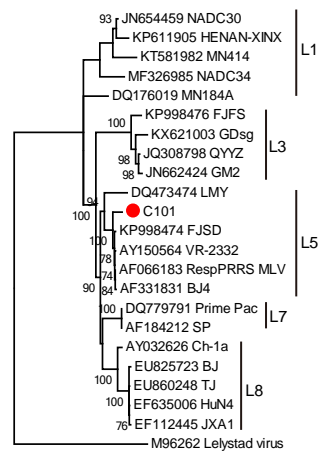
Fig. S1 RNA secondary structure of the PRRSV NSP9 and ORF2–4 predicted by mfold, recombination hotspots were mapped on the secondary structure and marked by red circles.

Supplementary Figure 2

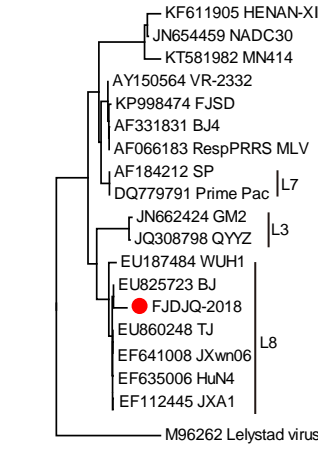
C101



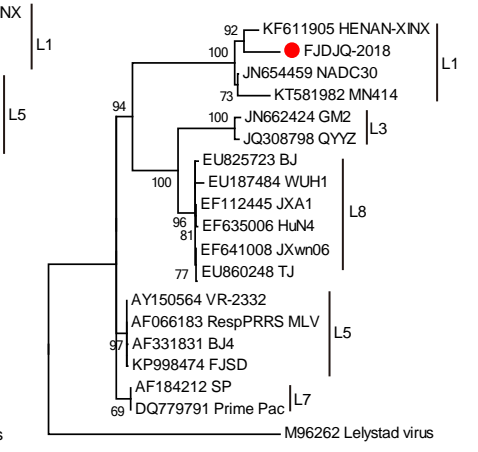
FJDJQ-2018



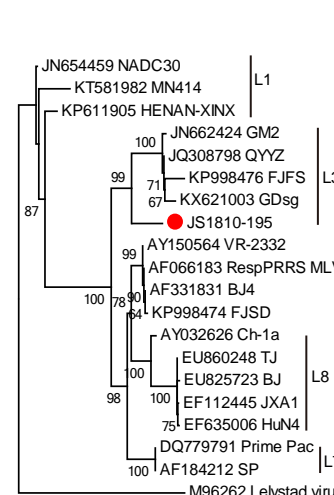
FJDJQ-2018



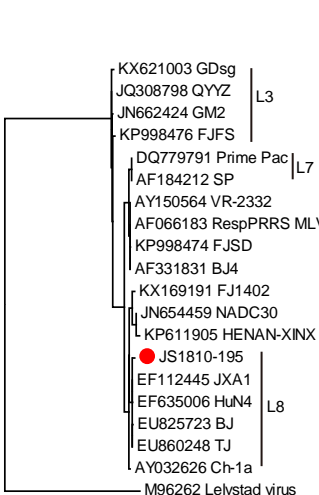
FJDJQ-2018



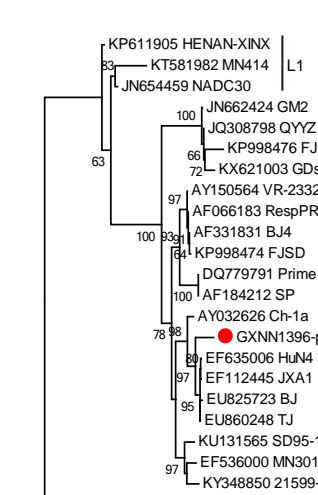
JS1810-195



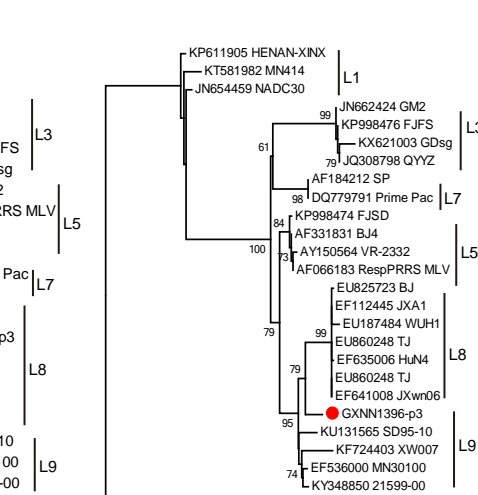
JS1810-195



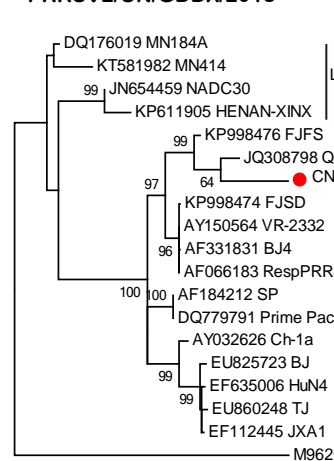
GXNN1396



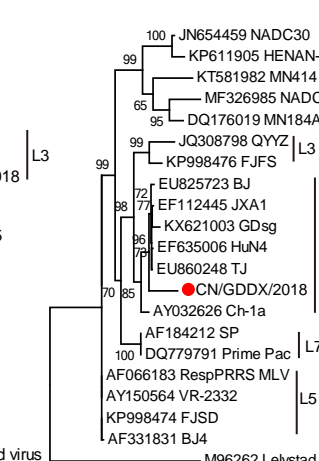
GXNN1396



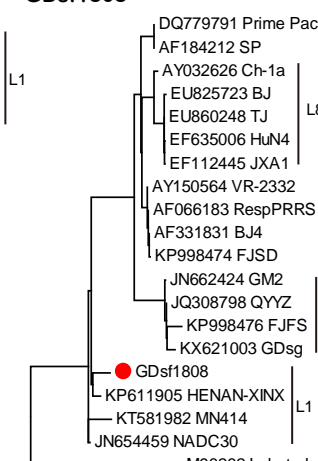
PRRSV2/CN/GDDX/2018



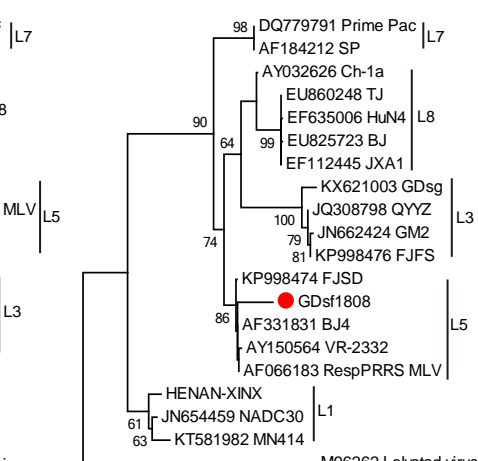
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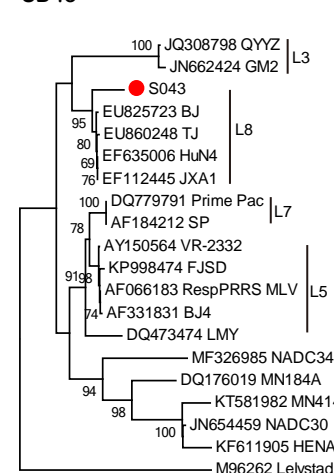
GDSf1808



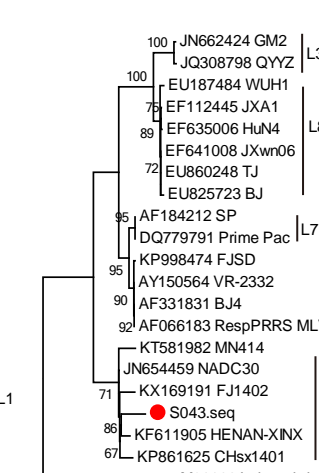
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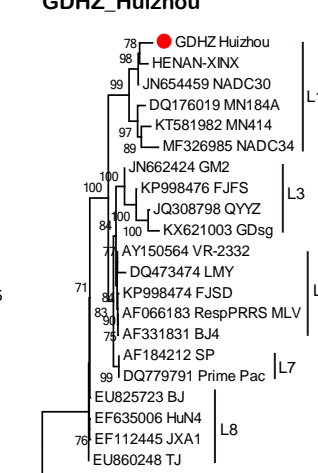
SD43



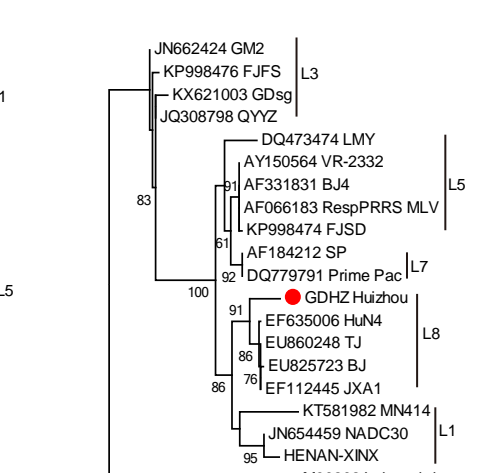
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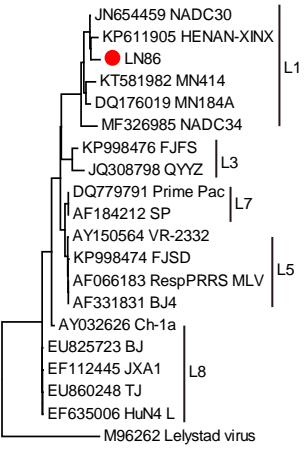
GDHZ_Huizhou



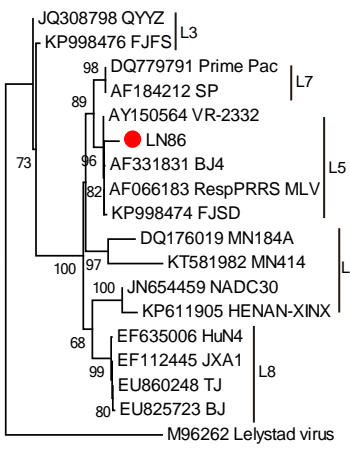
GDHZ_Huizhou



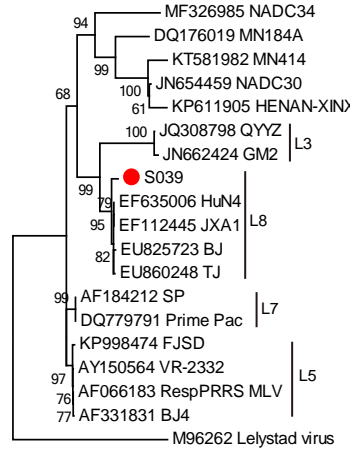
LN86



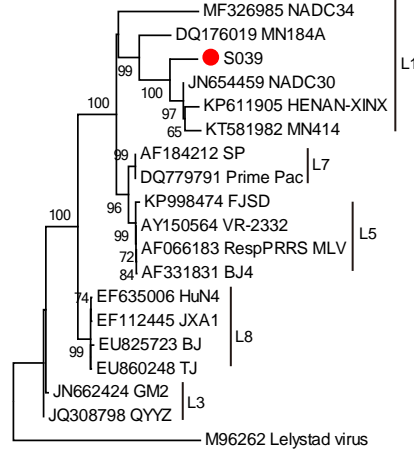
S039



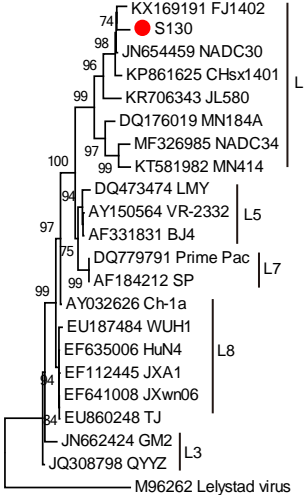
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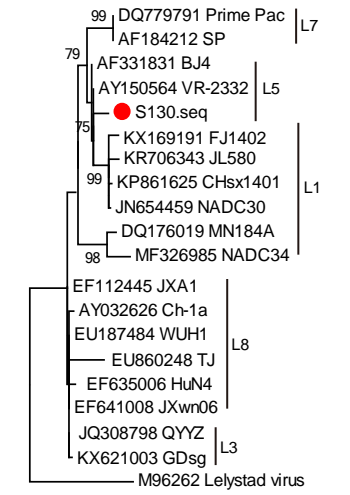
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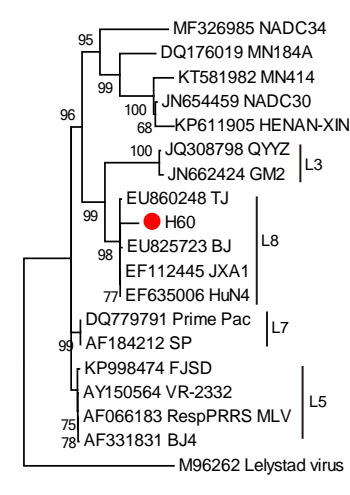
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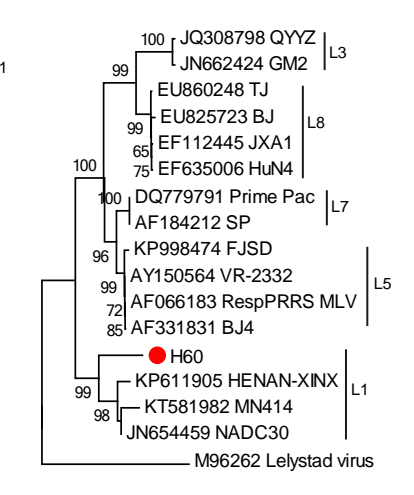
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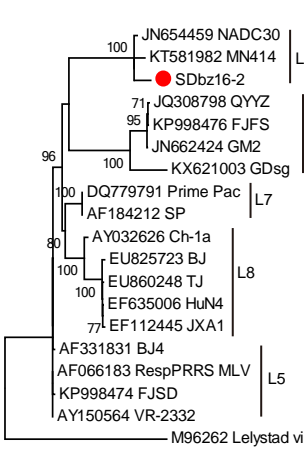
H60



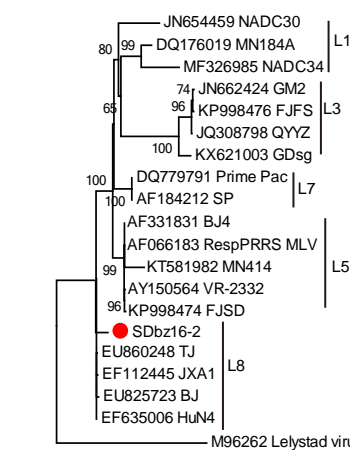
H60



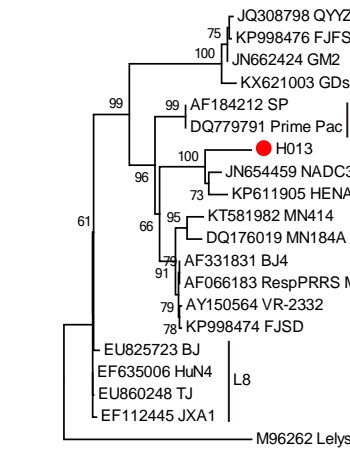
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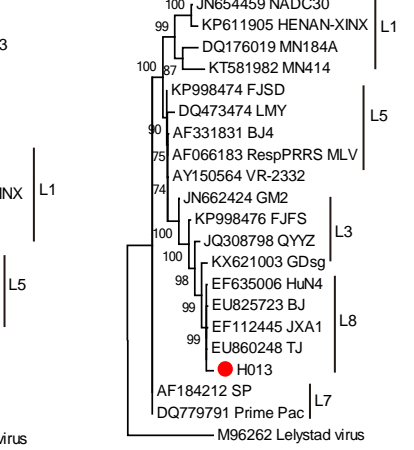
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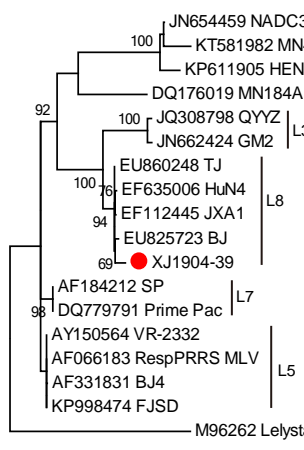
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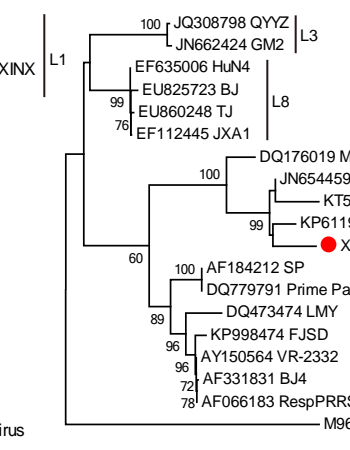
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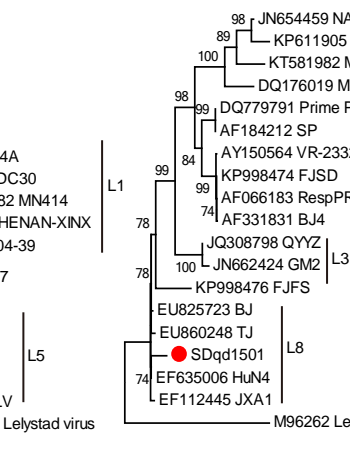
XJ1904-39



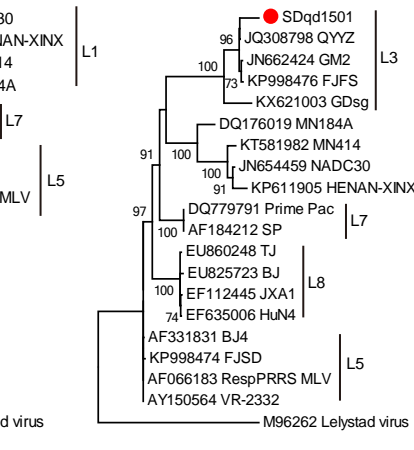
XJ1904-39



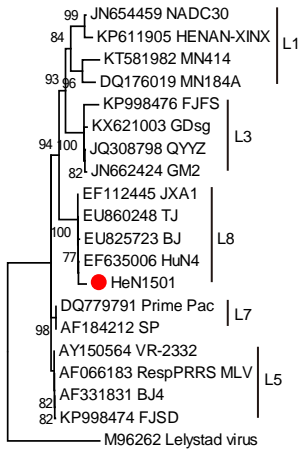
SDqd1501



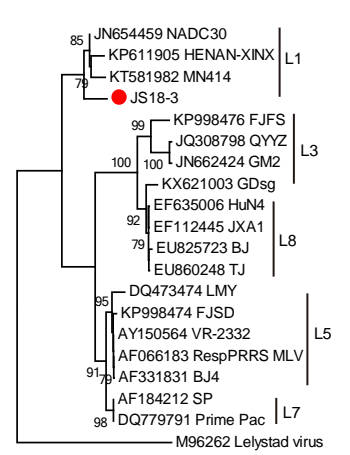
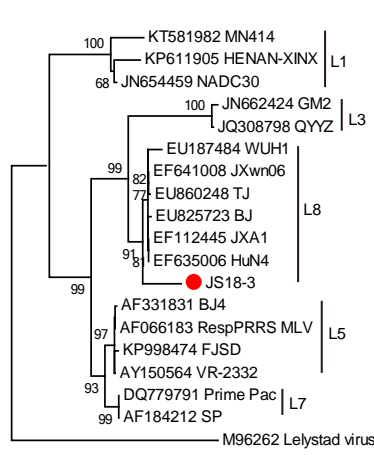
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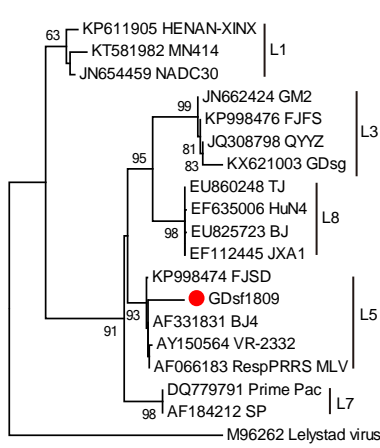
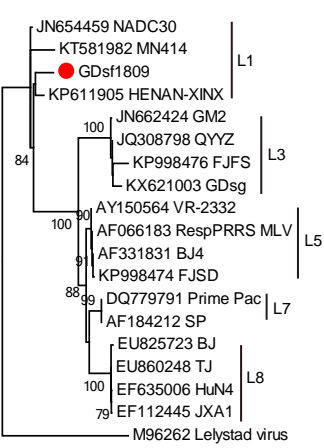
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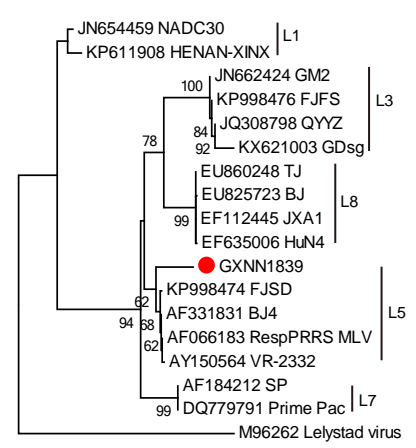
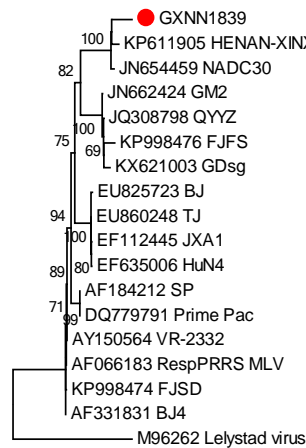
JS18-3



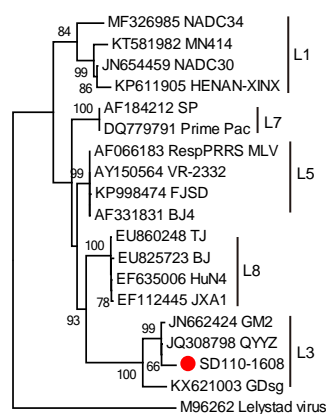
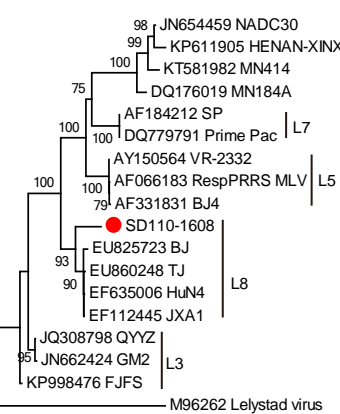
GDsf1809



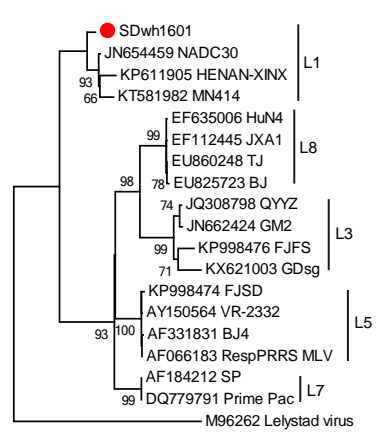
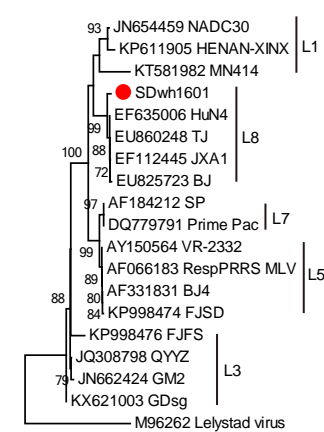
GXNN1839



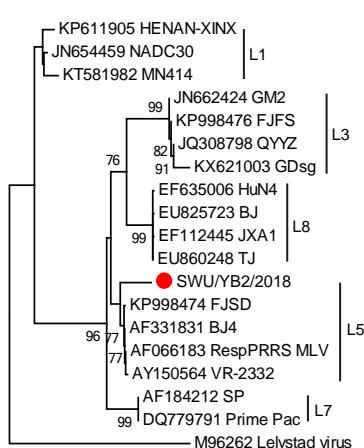
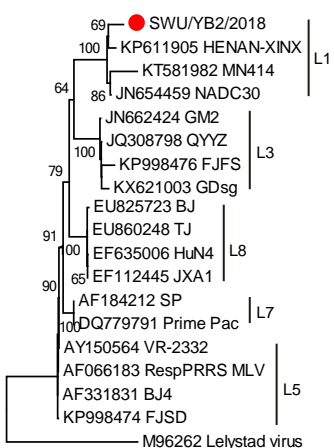
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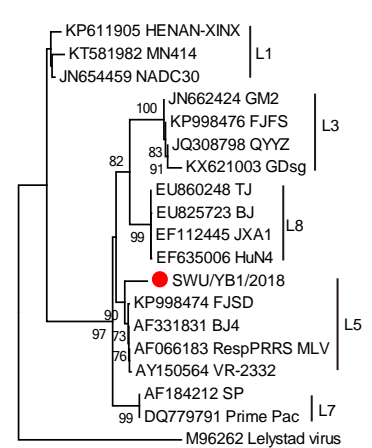
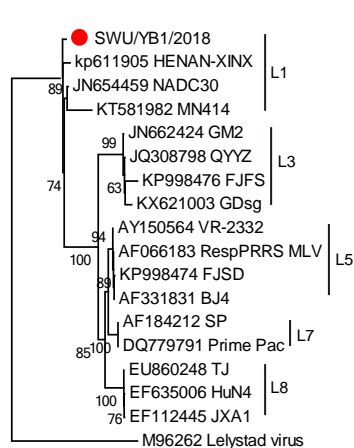
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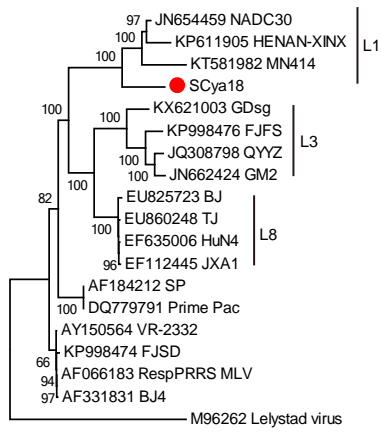
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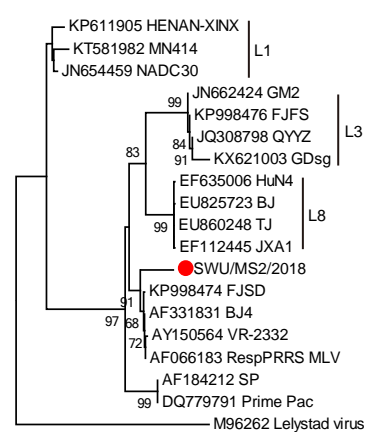
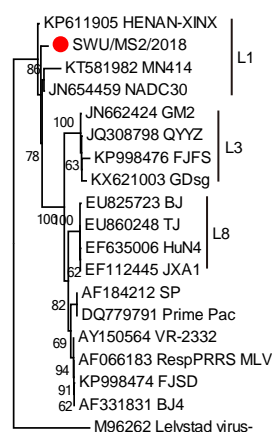
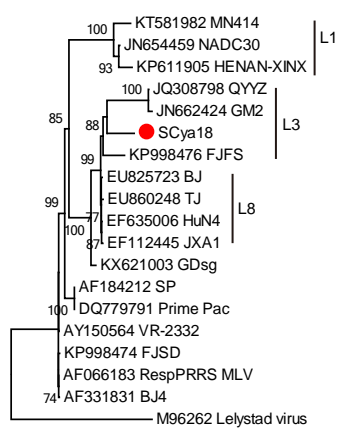
SWU/YB1/2018



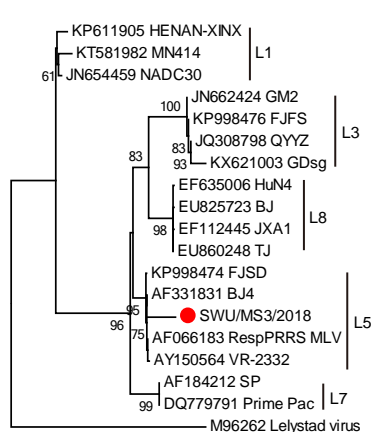
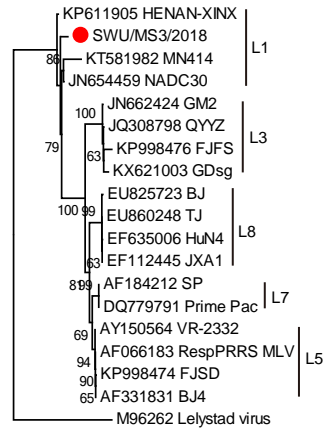
SCya18



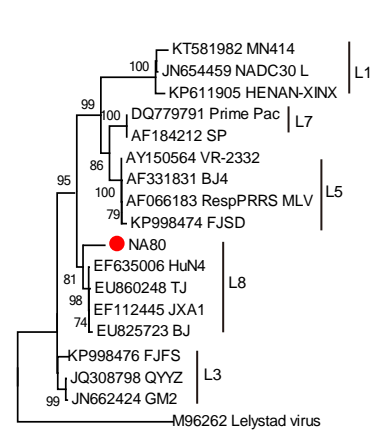
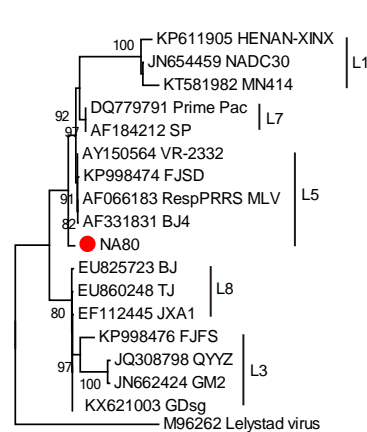
SWU/MS2/2018



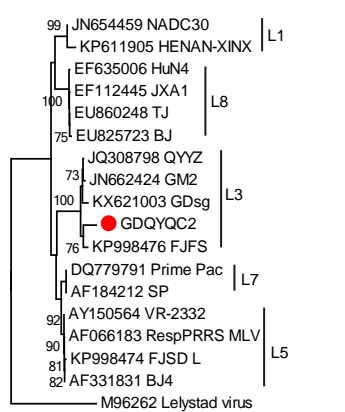
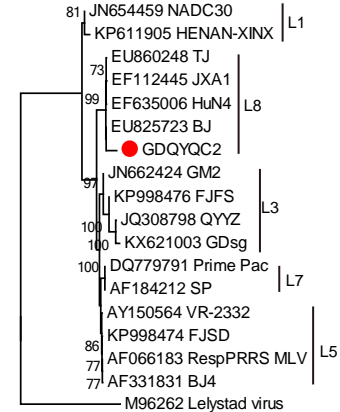
SWU/MS3/2018



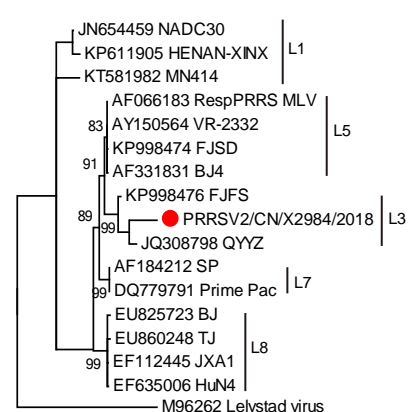
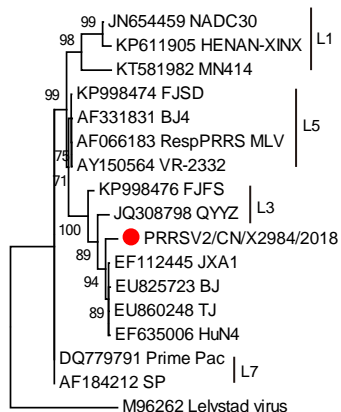
NA80



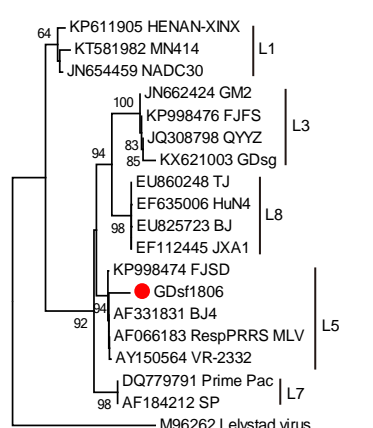
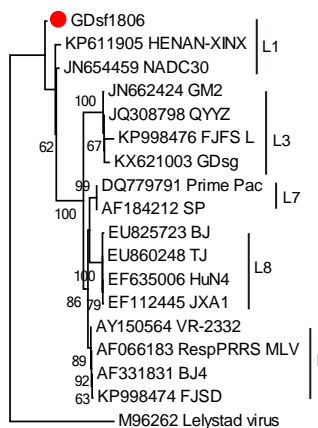
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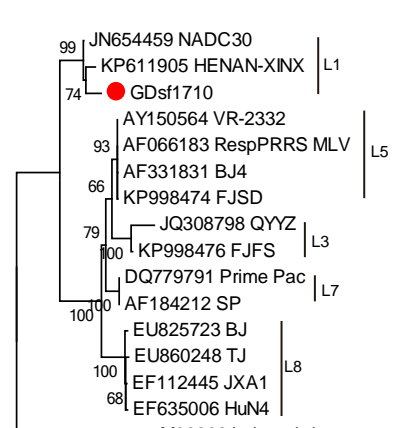
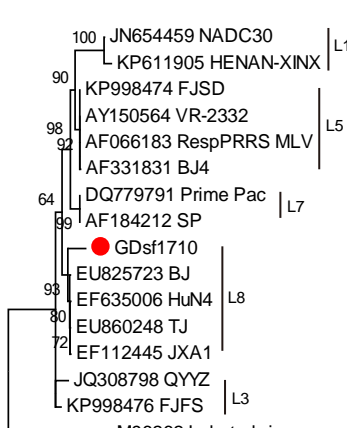
PRRSV/CN/X2984/2018



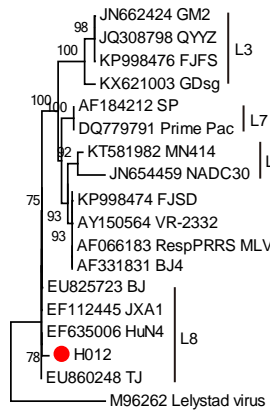
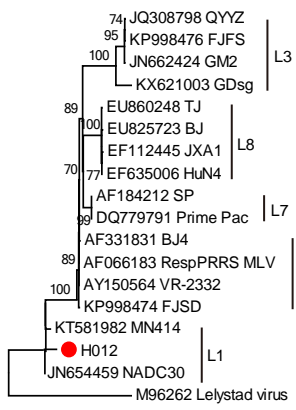
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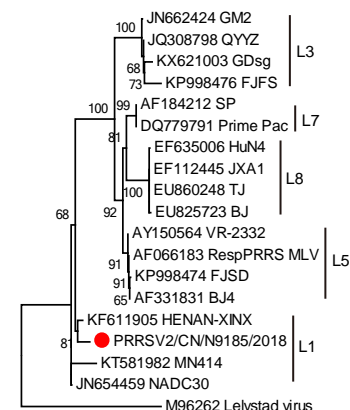
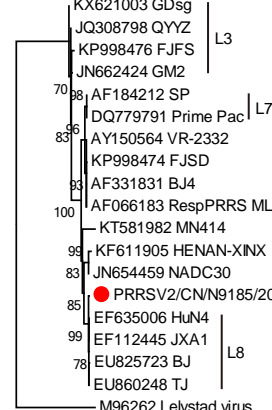
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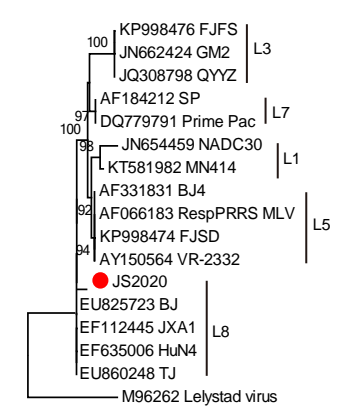
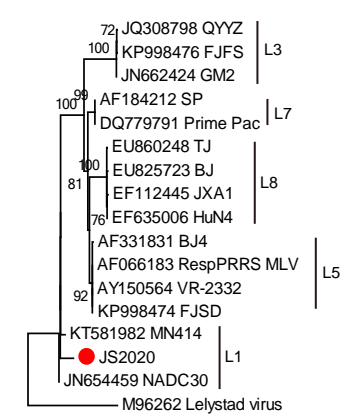
H012



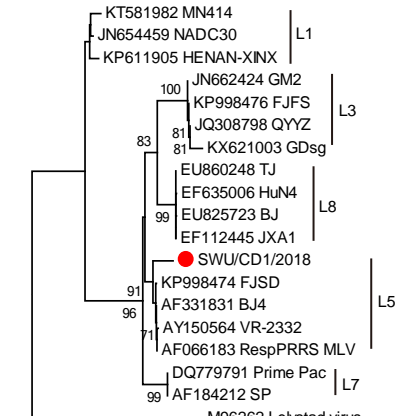
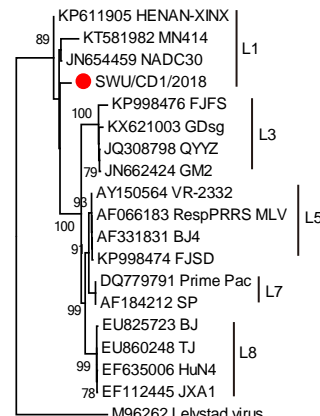
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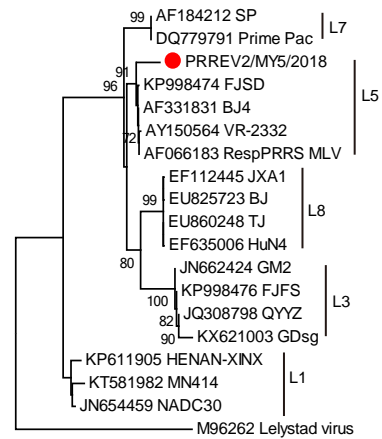
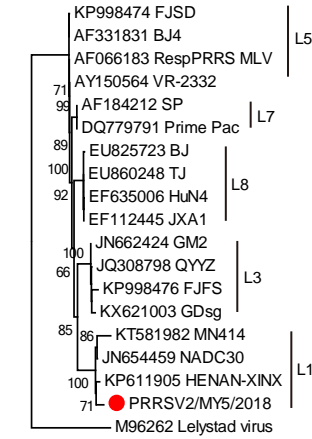
JS2020



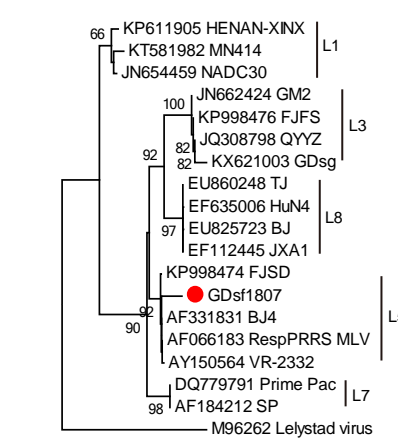
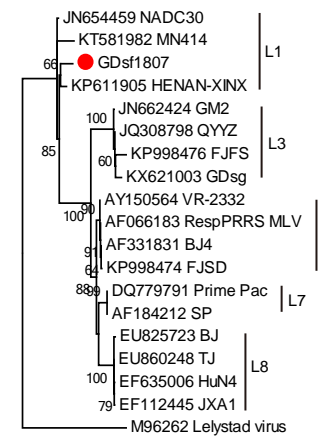
SWU/CD1/2018



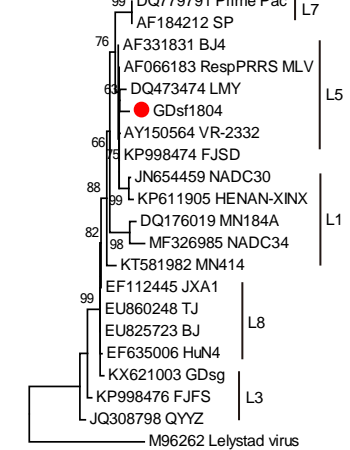
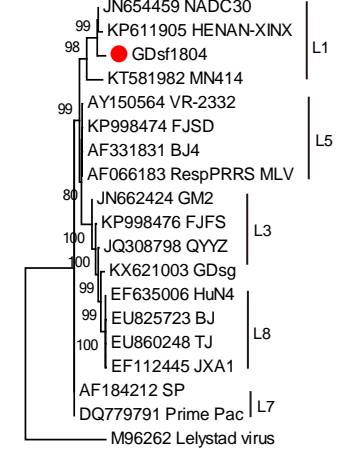
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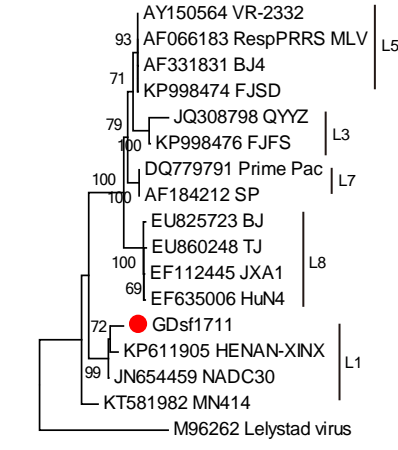
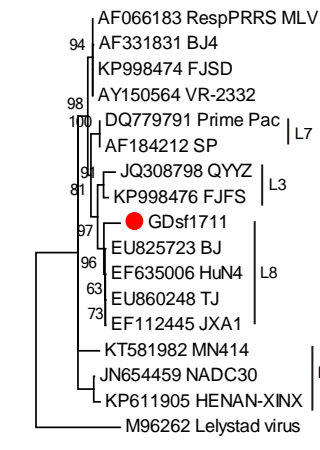
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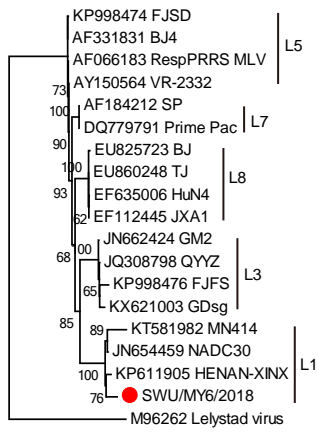
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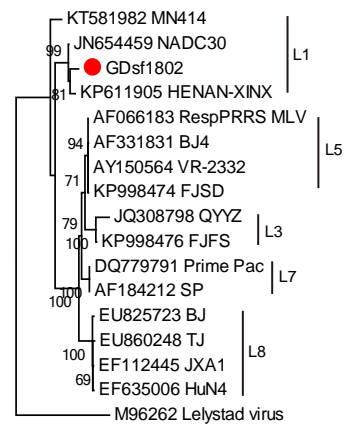
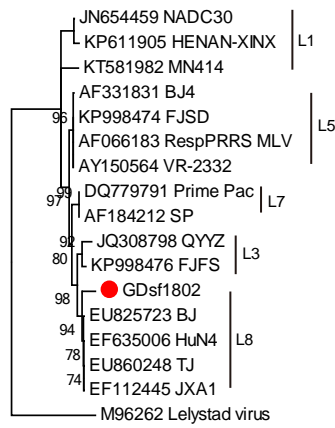
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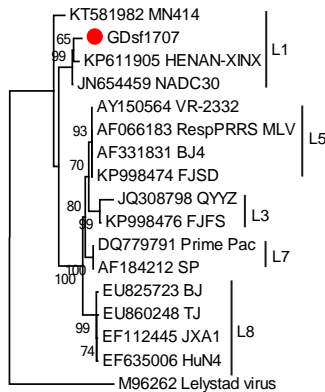
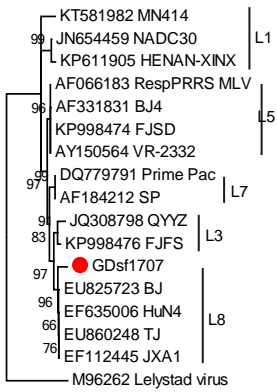
SWU/MY6/2018



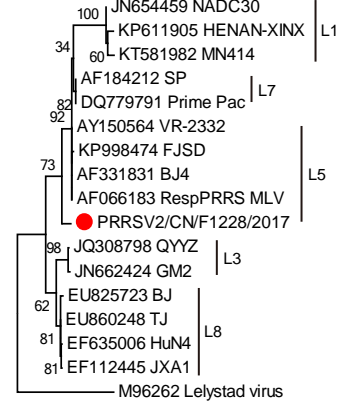
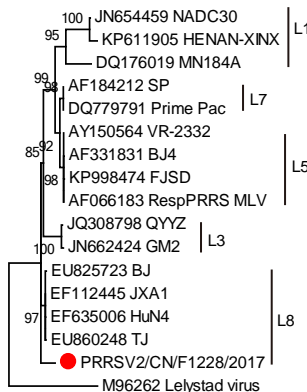
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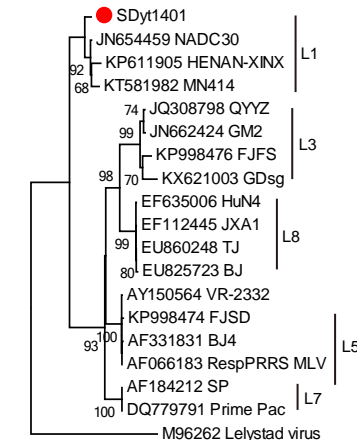
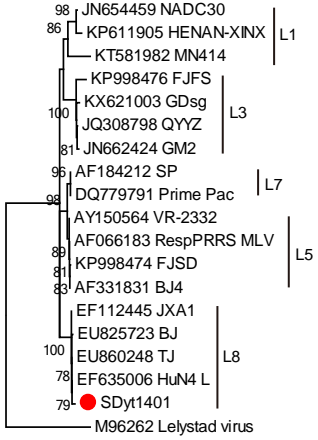
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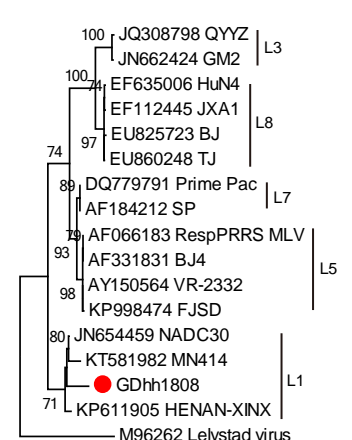
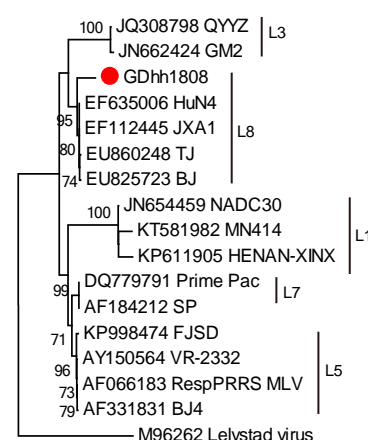
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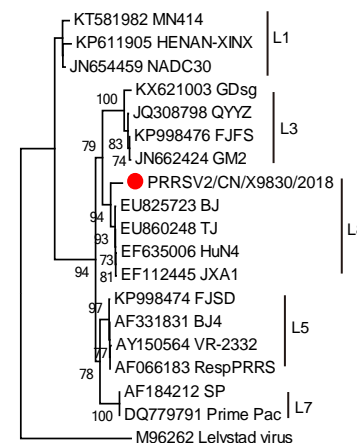
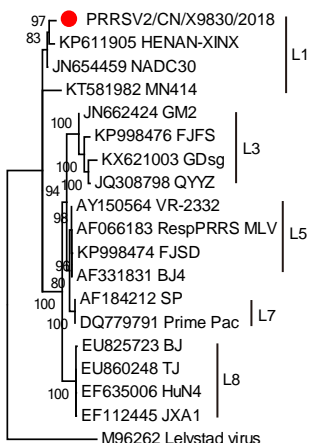
SDyt1401



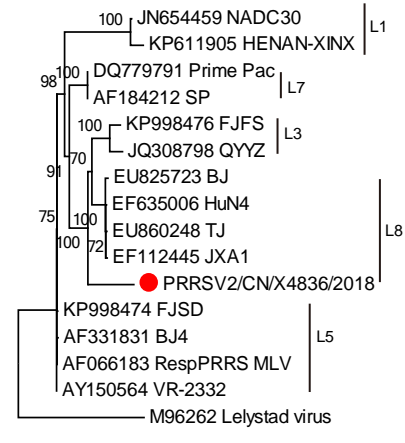
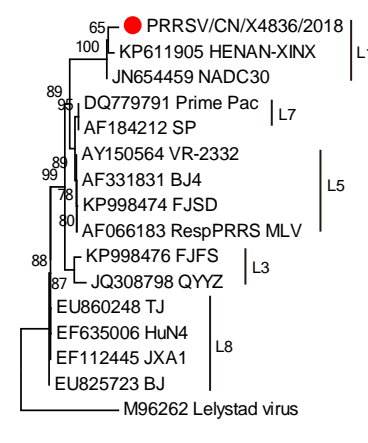
GDhh1808



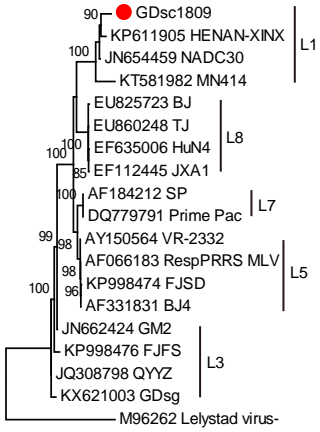
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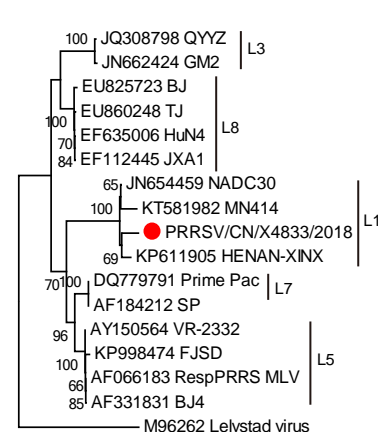
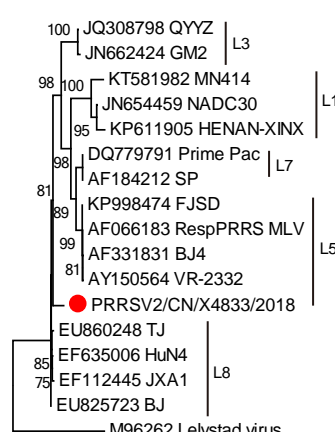
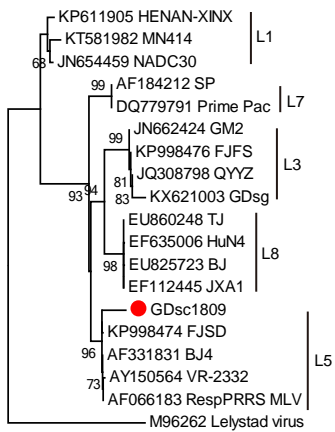
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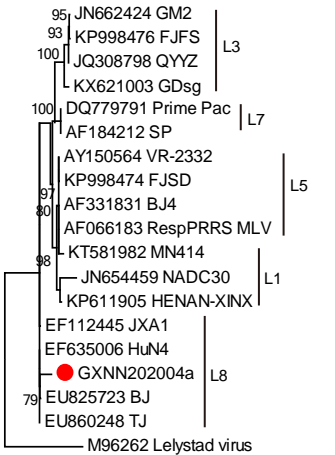
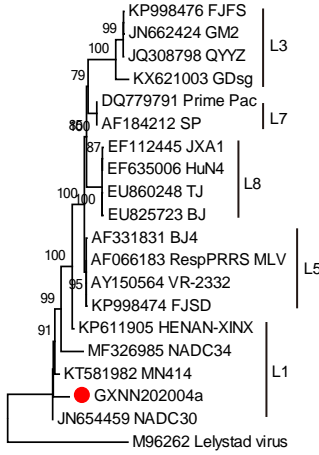
GDsc1809



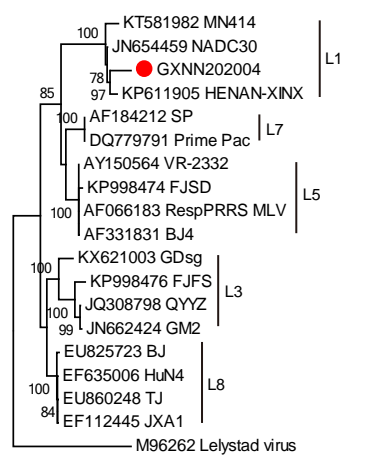
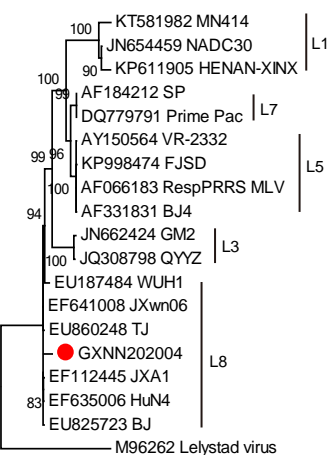
PRRSV2/CN/X4833/2018



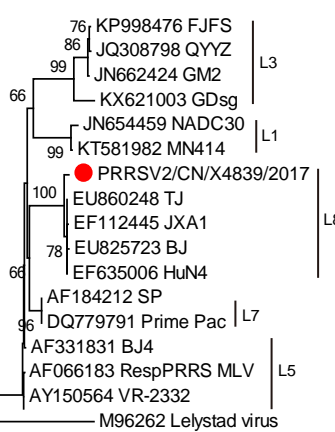
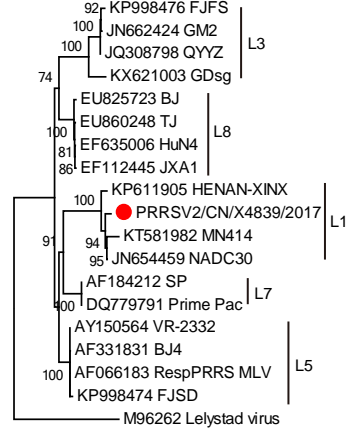
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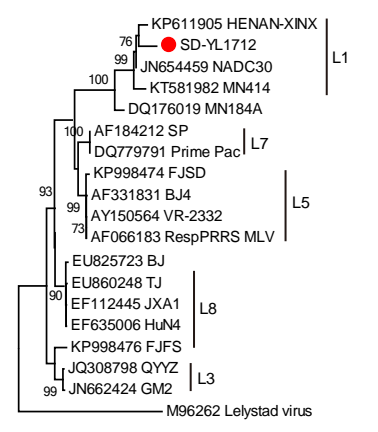
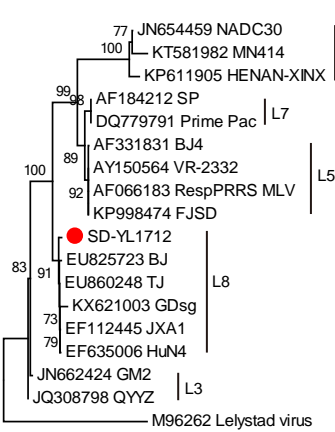
GXNN202004



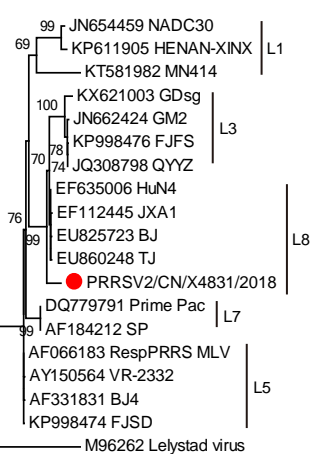
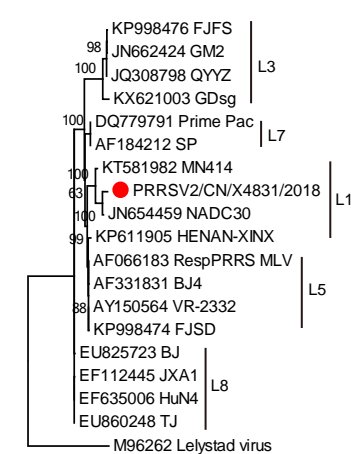
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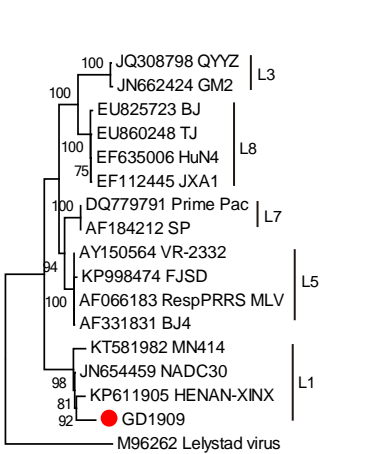
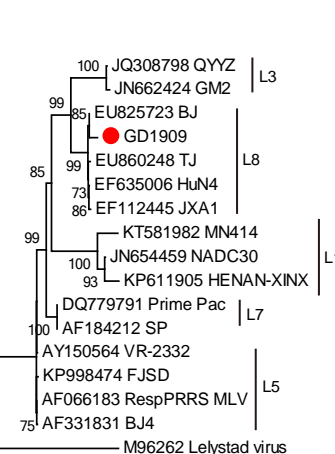
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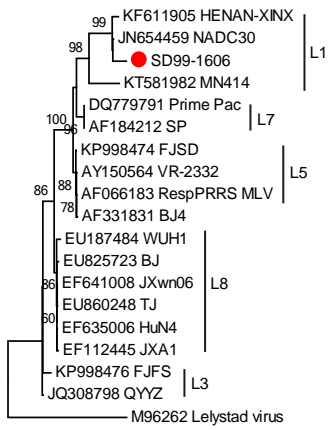
PRRSV2/CN/X4831/2018



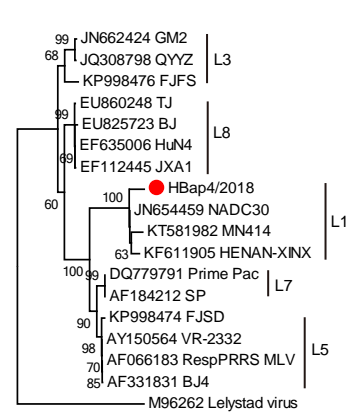
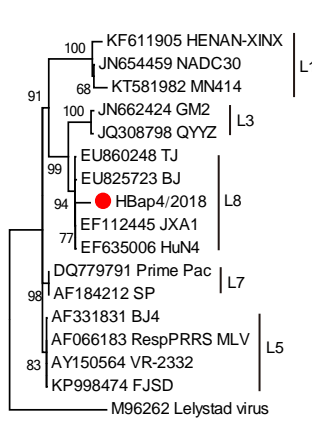
GD1909



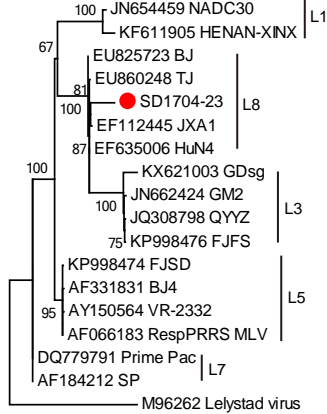
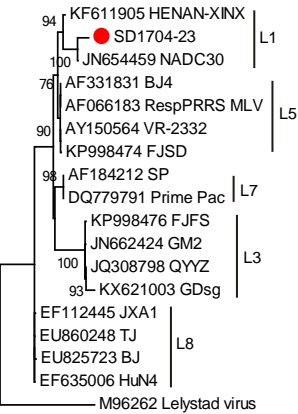
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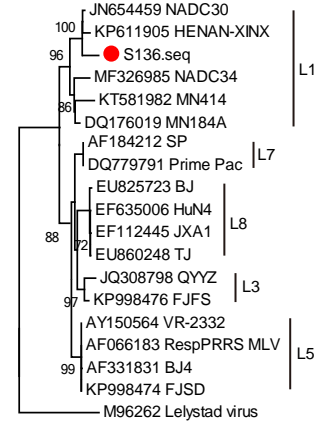
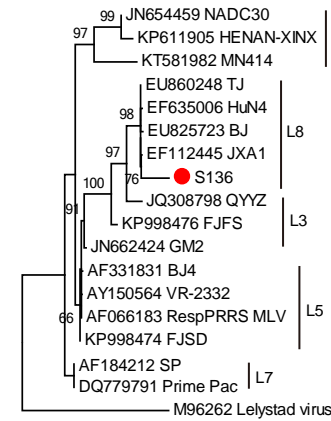
HBap4/2018



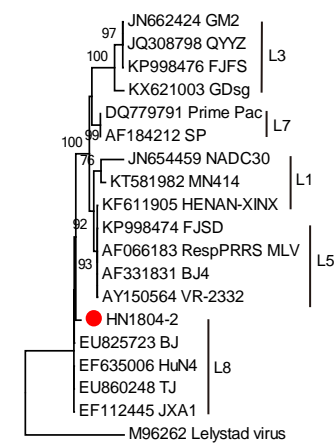
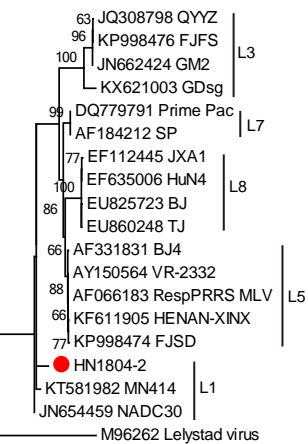
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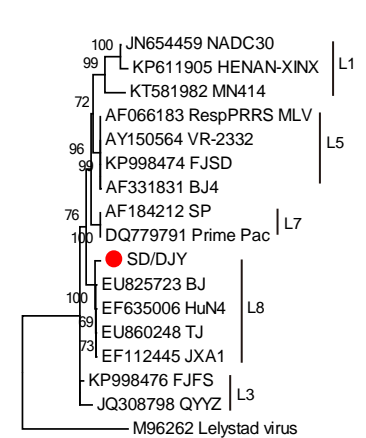
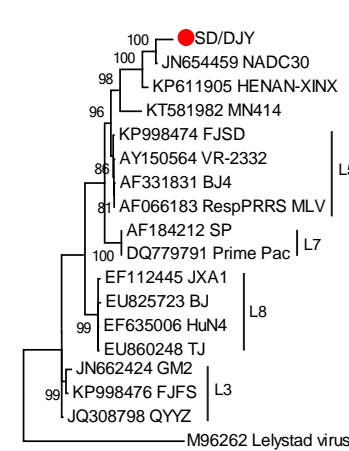
S136



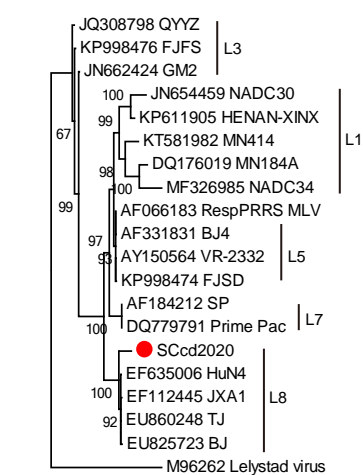
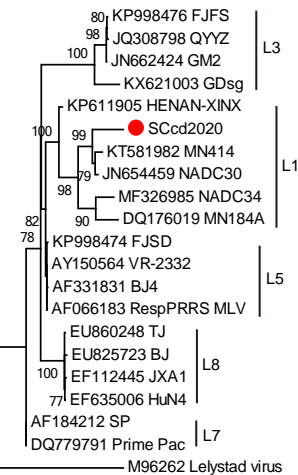
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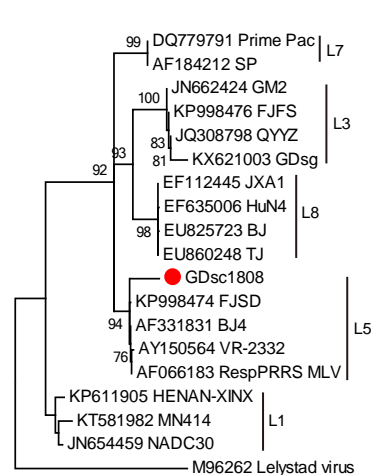
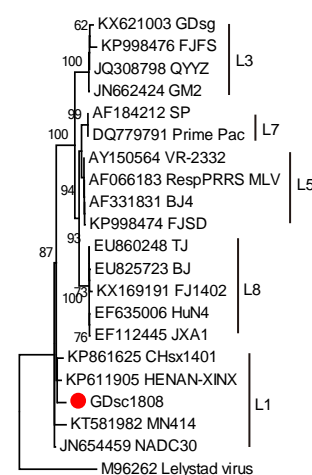
SD/DJY



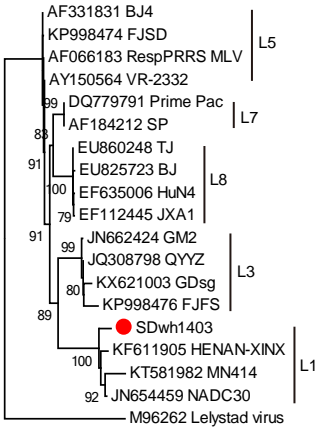
SCcd2020



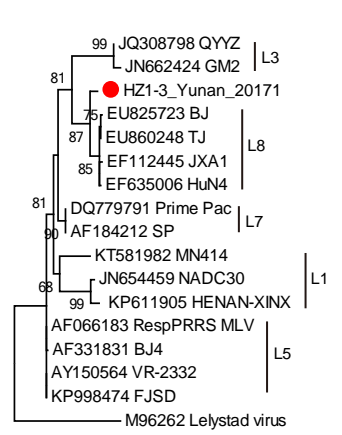
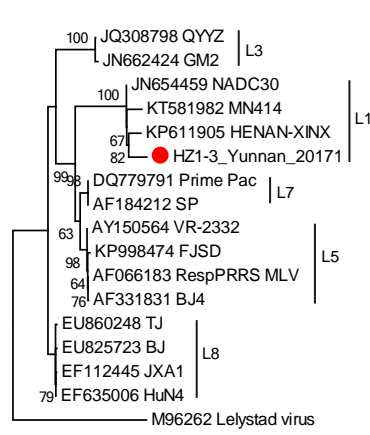
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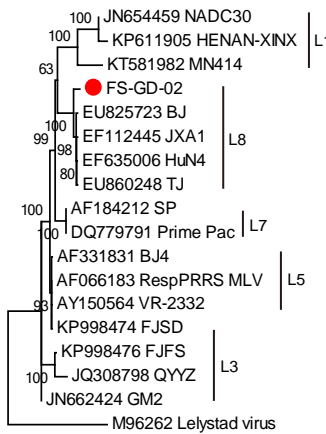
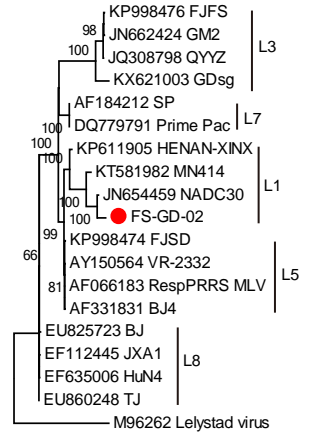
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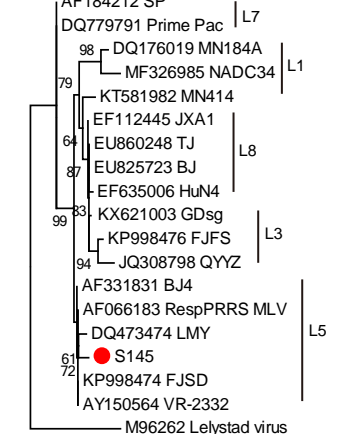
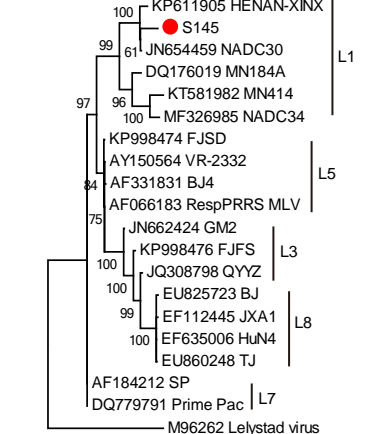
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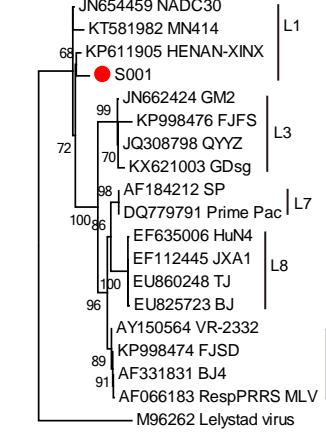
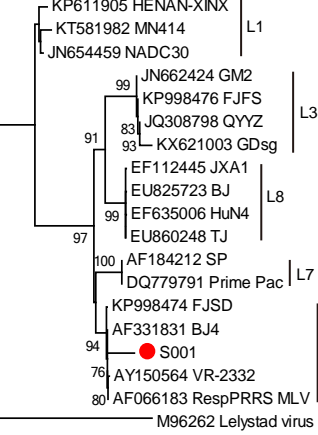
FS-GD-02



S145



S001



PRRSV2/CN/110713/2018

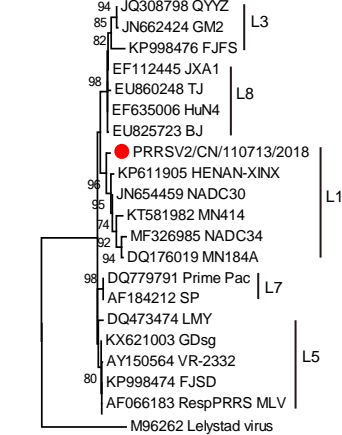
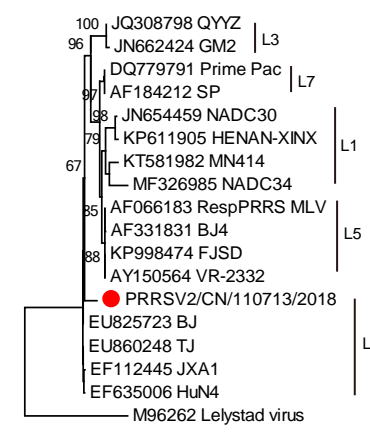


Fig. S2 Phylogenetic analysis based on the recombinant region of recombinant strains.

Supplementary Table 1. Strains information used in this study.

Accession number	Strain	Date	Country	Province/ States	Lineage
AF176348	PA8	na	Canada	Alberta	L5
	HB94-lun	2019	China	Hebei	L1
	S145	2019	China	Shandong	L1
	S130-lym	2019	China	Shandong	L1
	G52	2018	China	Guangdong	L8
	G101-lun	2019	China	Guangdong	L5
	S039	2018	China	Shandong	L1
	S75	2018	China	Shandong	L8
	S022-lun	2018	China	Shandong	L8
	H60-lun	2018	China	Hebei	L1
	NA80-lun	2018	China	Heilongjiang	L5
	HB96-lun	2019	China	Hebei	L5
	LN86-lun	2018	China	Liaoning	L1
	G122-lun	2018	China	Guangdong	L8
	S032-lun	2018	China	Shandong	L8
	S78-lun	2018	China	Shandong	L1
	H013	2018	China	Hebei	L1
	S77	2018	China	Shandong	L1
	S020	2018	China	Shandong	L1
	S70	2018	China	Shandong	L3
	G59-lun	2018	China	Guangdong	L3
	G128-lun	2018	China	Guangdong	L3
	C103-lun	2019	China	Chongqing	L5
	G113-lun	2018	China	Guangdong	L3
	S043	2018	China	Shandong	L1
	S136-lun	2019	China	Shandong	L1
	H012	2018	China	Hebei	L1
	S001-lun	2018	China	Shandong	L1
	H64	2019	China	Heilongjiang	L1
	ZJ83-lun	2018	China	Zhejiang	L3
	AF331831	BJ-4	1997	China	Beijing
AY032626	CH-1a	1996	China	Beijing	L8
AY150312	HB-1(sh)/2002	2002	China	Hebei	L8
AY262352	HB-2(sh)/2002	2002	China	Hebei	L8
AY457635	HN1	na	China	Hunan	L5
DQ459471	S1	na	China	na	L5
EF075945	HUB1	2006	China	Hubei	L8
EF112445	JXA1	2006	China	Jiangxi	L8
EF112446	HUB2	2006	China	Hubei	L8
EF112447	HEB1	2006	China	Hebei	L8

EF153486	CC-1	2005	China	Jilin	L5
EF517962	HuN	na	China	Hunan	L8
EF635006	HUN4	2006	China	Hunan	L8
EF641008	JXwn06	2006	China	Jiangxi	L8
EU097706	NX06	2006	China	Ningxia	L8
EU097707	BJsy06	2006	China	Beijing	L8
EU106888	SHH	2006	China	Shanghai	L8
EU109502	LN	2006	China	Liaoning	L8
EU109503	GD	2006	China	Guangdong	L8
EU144079	SY0608	2006	China	Jiangsu	L8
EU187484	WUH1	2007	China	Hubei	L8
EU200961	Jiangxi-3	na	China	Jiangxi	L8
EU200962	Henan-1	na	China	Henan	L8
EU236259	HPBEDV	na	China	na	L8
EU262603	Em2007	2007	China	Hubei	L8
EU624117	XH-GD	2007	China	Guangdong	L8
EU678352	WUH2	na	China	Hubei	L8
EU708726	JX143	2006	China	Jiangxi	L8
EU825723	BJ	2007	China	Beijing	L8
EU825724	GD	2007	China	Guangdong	L8
EU860248	TJ	2006	China	Tianjin	L8
EU860249	NM1	2007	China	Inner	L8
				Mongolia	
EU864231	CG	2007	China	na	L8
EU864232	SHB	2005	China	na	L8
EU864233	TP	2006	China	na	L8
EU880431.2	GS2008	2008	China	Gansu	L8
EU880432.2	JX2006	2006	China	Jiangxi	L8
EU880433.2	GD2007	2007	China	Guangdong	L8
EU880434.2	SX2007	2007	China	Shanxi	L8
EU880435.2	YN2008	2008	China	Yunnan	L8
EU880436	XL2008	2008	China	na	L8
EU880437.2	HN2007	2007	China	Hunan	L8
EU880438	CH2002	2002	China	na	L8
EU880439	CH2004	2004	China	na	L8
EU880440	CH2003	2003	China	na	L8
EU880441.2	GS2002	2002	China	Gansu	L5
EU880442.2	GS2003	2003	China	Gansu	L5
EU880443.3	GS2004	2004	China	Gansu	L5
EU939312	JSyx	2006	China	Jiangsu	L8
FJ175687	PRRSV01	na	China	na	L5
FJ175688	PRRSV02	na	China	na	L5
FJ175689	PRRSV03	na	China	na	L5

FJ393456	07NM	2007	China	Inner Mongolia	L8
FJ393457	07HEN	2007	China	Henan	L8
FJ393458	07HEBTJ	2007	China	Hebei	L8
FJ393459	07BJ	2007	China	Beijing	L8
FJ536165	NB/04	2004	China	Zhejiang	L8
FJ797690	HN-HW	2006	China	Hunan	L8
FJ889129	CBB-1-F3	2008	China	na	L8
FJ889130	CWZ-1-F3	2008	China	na	L8
FJ895329	SX2009	2009	China	Shanxi	L8
FJ950744	BJSY-1	2007	China	Beijing	L8
FJ950745	BJBLZ	2007	China	Beijing	L8
FJ950746	BJPG	2007	China	Beijing	L8
FJ950747	BJSD	2007	China	Beijing	L8
GQ330474	APRRS	na	China	na	L7
GQ351601	BJ0706	2007	China	Beijing	L8
GQ359108	SD-CXA/2008	2008	China	Shandong	L8
GQ374441	GDQJ	2007	China	Guangdong	L8
GQ374442	GDBY1	2008	China	Guangdong	L8
GQ857656	SX-1	na	China	Shanxi	L8
GQ914997	SD1-100	na	China	Shandong	L1
GU143913	GD	2009	China	Guangdong	L8
GU168567	09HUB7	2009	China	Hubei	L8
GU168568	09HUB5	2009	China	Hubei	L8
GU168569	08SDWF	2008	China	Shandong	L8
GU169411	08HuN	2008	China	Hunan	L8
GU232735	KP	2008	China	na	L8
GU232738	YN9	2008	China	Yunnan	L8
GU269541	GD3	2005	China	Guangdong	L8
GU454850	GDQY2	2007	China	Guangdong	L8
GU461292	AH0701	2007	China	Anhui	L8
HM011104	BJSY07	2007	China	Beijing	L8
HM016158	JN-HS	2008	China	Shandong	L8
HM016159	ZP-1	2009	China	Shandong	L8
HM189676	HLJHL	2009	China	Heilongjiang	L8
HM214913	GX09-16	2009	China	Guangxi	L8
HM214914	GX09-29	2009	China	Guangxi	L8
HM214915	GX09-32	2009	China	Guangxi	L8
HM853673.2	WUH3	2008	China	Hubei	L8
HQ315835	BB0907	2009	China	Guangxi	L8
HQ315836	NT0801	2008	China	Jiangsu	L8
HQ315837	SY0909	2009	China	Jiangsu	L8
HQ401282	Shaanxi-2	2007	China	Shaanxi	L8

HQ416720	TA-12	2008	China	Shandong	L8
HQ843178	HLJ-09	2009	China	Henan	L8
HQ843179	HLM-09	2009	China	Henan	L8
HQ843180	SD-09	2009	China	Shandong	L8
HQ843181	SX-09	2009	China	Shanxi	L8
JF268672	09SC	2009	China	Sichuan	L8
JF268673	09HUN1	2009	China	Hunan	L8
JF268674	09HUN2	2009	China	Hunan	L8
JF268675	09JS	2009	China	Jiangsu	L8
JF268676	09BJ	2009	China	Beijing	L8
JF268677	09DB1	2009	China	na	L8
JF268678	09SD	2009	China	Shandong	L8
JF268679	09HEB	2009	China	Hebei	L8
JF268680	09HEN2	2009	China	Henan	L8
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JF268682	09HUB1	2009	China	Hubei	L8
JF268683	09HUB2	2009	China	Hubei	L8
JF268684	09HEN1	2009	China	Henan	L8
JF748717	YD	2009	China	na	L8
JF748718	DC	2010	China	na	L8
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JF800911	ZCYZ	2009	China	Shandong	L8
JN256115	SD0901	2009	China	Shandong	L8
JN387271	GDQY1	2007	China	Guangdong	L8
JN662424	GM2	2011	China	Guangdong	L3
JN836553	SCwhn09CD	2009	China	Sichuan	L8
JN864948	DY	2007	China	Guangdong	L5
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JQ326271	WUH4	2011	China	Hubei	L8
JQ663540	10-10JX	2010	China	Jiangxi	L8
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JQ663546	10-10FUJ-1	2010	China	Fujian	L8
JQ663547	10-10FUJ-2	2010	China	Fujian	L8
JQ663548	10-10FUJ-3	2010	China	Fujian	L8
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JQ663560	10-10GX-3	2010	China	Guangxi	L8
JQ663561	10-10GX-4	2010	China	Guangxi	L8
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JQ715698	NVDC-JS2-2011	2011	China	Jiangsu	L8
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JQ955658	GX1002	2010	China	Guangxi	L8
JX087437	SD16	2012	China	Shandong	L8
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JX215553	10HD-GD	2010	China	Guangdong	L8
JX215554	11FS12-GD	2011	China	Guangdong	L8
JX217036	11NZ-GD	2011	China	Guangdong	L8
JX235365	11SH-GD	2011	China	Guangdong	L8
JX235366	11SH1-GD	2011	China	Guangdong	L8
JX235367	11XX-GD	2011	China	Guangdong	L8
JX235370	11GZ-GD	2011	China	Guangdong	L8
JX317648	HV	2007	China	Na	L8
JX317649	JX	2010	China	Jiangxi	L8
JX679179	HH08	2011	China	Heilongjiang	L8
JX857698	YN-2011	2011	China	Yunan	L5
JX878379	SDA2	2011	China	Shandong	L8
JX878380	SDA3	2011	China	Shandong	L8
JX880029	NJ-1106	2011	China	Jiangsu	L8
JX912249	GX1003	2010	China	Guangxi	L8

KC445138	HZ-31	2012	China	na	L5
KC527830	GD-2011	2011	China	Guangdong	L8
KF287132	HK1	2003	China	Hongkong	L8
KF287133	HK2	2003	China	Hongkong	L3
KF287134	HK4	2003	China	Hongkong	L8
KF287135	HK6	2004	China	Hongkong	L3
KF287136	HK7	2004	China	Hongkong	L8
KF287137	HK9	2004	China	Hongkong	L3
KF287138	HK11	2004	China	Hongkong	L3
KF287139	HK12	2004	China	Hongkong	L8
KF287140	HK13	2005	China	Hongkong	L8
KF287141	HK14	2004	China	Hongkong	L5
KF287142	HK15	2004	China	Hongkong	L3
KF287143	HK16	2004	China	Hongkong	L3
KF611905	HENAN-XINX	2013	China	Henan	L1
KF678434	SH1211	2012	China	Shanghai	L3
KF751237	BJ1102	2011	China	Beijing	L8
KF751238	LN1101	2011	China	Liaoning	L8
KF771273	GZ1101	2011	China	Guizhou	L5
KF815525	XJu-1	2012	China	Xinjiang	L8
KJ002451	HeNan-A1	2013	China	Henan	L8
KJ002452	HeNan-A2	2013	China	Henan	L8
KJ019330	Henan-A3	2013	China	Henan	L8
KJ143621	HENAN-HEB	2012	China	Henan	L1
KJ534539	Henan-A4	2013	China	Henan	L8
KJ534540	Henan-A5	2013	China	Henan	L8
KJ534541	Henan-A6	2013	China	Henan	L8
KJ534542	Henan-A7	2013	China	Henan	L8
KJ534543	Henan-A8	2013	China	Henan	L8
KJ541663	GZ106	2005	China	Guizhou	L8
KJ546412	HeNan-A9	2013	China	Henan	L8
KJ591659	HEB-2013	2013	China	Hebei	L8
KJ609516	MY-486	2013	China	Henan	L8
KJ609517	MY-376	2013	China	Henan	L8
KJ747052	YN-1	2011	China	Yunnan	L8
KJ819934	Henan-A12	2014	China	Henan	L8
KJ819935	Henan-A13	2014	China	Henan	L8
KJ819936	Henan-A14	2014	China	Henan	L8
KJ855518	Shanxi-6	2010	China	Shanxi	L8
KM000066	NMG2014	2014	China	Inner Mongolia	L8
KM189443	SC2012	2012	China	Sichuan	L8
KM261784	HB2014001	2014	China	Hubei	L8

KP162169	HB-XL	2014	China	na	L8
KP179402	NT1	na	China	Jiangsu	L8
KP179403	NT2	na	China	Jiangsu	L8
KP179404	NT3	na	China	Jiangsu	L8
KP330232	HUN-2014	2014	China	Hunan	L8
KP742986	TJbd14-1	2014	China	Tianjin	L8
KP742987	TJbd14-2	2014	China	Tianjin	L8
KP771735	NVDC-SHH02-2014	2014	China	Shanghai	L8
KP771736	NVDC-shh01-2014	2014	China	Shanghai	L8
KP771737	NVDC-SD6-2014	2014	China	Shandong	L8
KP771738	NVDC-SD1-2014	2014	China	Shandong	L8
KP771739	NVDC-SC1-2014	2014	China	Sichuan	L8
KP771740	NVDC-SXJC-2013	2013	China	Shanxi	L8
KP771741	NVDC-SDXX-2013	2013	China	Shandong	L8
KP771742	NVDC-HBCZ-2013	2013	China	Hubei	L8
KP771743	NVDC-BJPG-2013	2013	China	Beijing	L8
KP771744	NVDC-HeB2-2013	2013	China	Hebei	L8
KP771745	NVDC-HeB1-2013	2013	China	Hebei	L8
KP771746	NVDC-CQ1-2011	2011	China	Chongqing	L8
KP771747	NVDC-CQ1-2012	2012	China	Chongqing	L8
KP771748	NVDC-BJ2-2011	2011	China	Beijing	L8
KP771749	NVDC-HeB1-2011	2011	China	Hebei	L8
KP771750	NVDC-MD2-2013	2013	China	na	L8
KP771751	NVDC-MD1-2013	2013	China	na	L8
KP771752	HEB 20130008-14	2013	China	Hebei	L8
KP771753	HEB 20130008-13	2013	China	Hebei	L8
KP771754	NVDC-HeB-2008	2008	China	Hebei	L8
KP771755	NVDC-CQ-2008	2008	China	Chongqing	L8
KP771756	NVDC-BJ9-2012	2012	China	Beijing	L8
KP771757	NVDC-BJ8-2012	2012	China	Beijing	L8
KP771758	NVDC-BJ7-2012	2012	China	Beijing	L8
KP771759	NVDC-BJ6-2012	2012	China	Beijing	L8
KP771760	NVDC-BJ5-2012	2012	China	Beijing	L8
KP771761	NVDC-BJ4-2012	2012	China	Beijing	L8
KP771762	NVDC-BJ3-2012	2012	China	Beijing	L8
KP771763	NVDC-BJ2-2012	2012	China	Beijing	L8
KP771764	NVDC-BJ1-2012	2012	China	Beijing	L8
KP771765	NVDC-HeB2-2011	2011	China	Hebei	L8
KP771766	NVDC-GD-2011	2011	China	Guangdong	L8
KP771767	NVDC-YN-2011	2011	China	Yunnan	L8
KP771768	NVDC-SD2-2012	2012	China	Shandong	L8
KP771769	NVDC-SD1-2012	2012	China	Shandong	L8
KP771770	NVDC-HuN-2011	2012	China	Hunan	L8

KP771771	NVDC-HeN-2012	2012	China	Henan	L8
KP771772	NVDC-HeB2-2012	2012	China	Hebei	L8
KP771773	NVDC-HeB1-2012	2012	China	Hebei	L8
KP771774	NVDC-CQ3-2011	2011	China	Chongqing	L8
KP771775	NVDC-CQ3-2012	2012	China	Chongqing	L8
KP771776	NVDC-CQ2-2012	2012	China	Chongqing	L8
KP771777	NVDC-CQ4-2012	2012	China	Chongqing	L8
KP771778	NVDC-BJ1-2011	2011	China	Beijing	L8
KP771779	NVDC-NM-2008	2008	China	Inner Mongolia	L8
KP771780	NVDC-13SXJC-2014	2014	China	Shanxi	L8
KP771781	NVDC-HuNCS-2014	2014	China	Hunan	L8
KP771782	NVDC-R38-2014	2014	China	na	L8
KP771783	NVDC-R224-2014	2014	China	na	L8
KP771784	NVDC-SD4-2014	2014	China	Shandong	L8
KP780881	14LY01-FJ	2014	China	Fujian	L8
KP780882	14LY02-FJ	2014	China	Fujian	L8
KP793736	GD-HD	2011	China	Guangdong	L8
KP860909	FJZ03	na	China	Fujian	L1
KP860910	FJY04	na	China	Fujian	L1
KP860911	FJW05	na	China	Fujian	L1
KP861625	CHsx1401	2014	China	Shanxi	L1
KP998401	17199	2005	China	Taiwan	L3
KP998402	312	2005	China	Taiwan	L3
KP998403	1483	2012	China	Taiwan	L3
KP998404	338	2011	China	Taiwan	L3
KP998406	HC120821-SH1	2012	China	Taiwan	L3
KP998407	HC120821-SH2	2012	China	Taiwan	L3
KP998408	HC120821-LL	2012	China	Taiwan	L3
KP998409	HC120904-CHYL	2012	China	Taiwan	L3
KP998410	JM	2011	China	Taiwan	L3
KP998412	25934	2008	China	Taiwan	L3
KP998413	310	2005	China	Taiwan	L3
KP998414	660	2009	China	Taiwan	L3
KP998415	803	2013	China	Taiwan	L3
KP998416	CH	2002	China	Taiwan	L3
KP998418	HL	2004	China	Taiwan	L3
KP998419	M1	2001	China	Taiwan	L3
KP998420	NT	2000	China	Taiwan	L3
KP998421	Q94-136	2005	China	Taiwan	L3
KP998422	TD/TP	1998	China	Taiwan	L3
KP998423	Tsai	1999	China	Taiwan	L3
KP998424	TY1	2000	China	Taiwan	L3

KP998425	TD1	1997	China	Taiwan	L3
KP998426	CH8V-J2	2003	China	Taiwan	L3
KP998427	TD-2	2004	China	Taiwan	L3
KP998429	WSV	1992	China	Taiwan	L5
KP998430	HC120629	2012	China	Taiwan	L3
KP998431	MD001	1991	China	Taiwan	L3
KP998474	FJSD	na	China	Fujian	L5
KP998475	FJE1	na	China	Fujian	L8
KP998476	FJFS	na	China	Fujian	L3
KP998477	FJCH	na	China	Fujian	L8
KP998478	FJZH	na	China	Fujian	L8
KP998479	FJOU	na	China	Fujian	L8
KR149645	JXja15	2015	China	Jiangxi	L8
KR706343	JL580	2013	China	Jilin	L1
KT022071	HNxa14	2014	China	Hunan	L8
KT022072	HNyc13	2013	China	Hunan	L8
KT180169	XF1129	2013	China	na	L8
KT351739	HLJA1	2013	China	Heilongjiang	L8
KT351740	HLJB1	2013	China	Heilongjiang	L8
KT358728	GZgy15-1	2015	China	Guizhou	L8
KT445876	HNP5	2014	China	na	L8
KT804696	FJYR	na	China	Fujian	L8
KT819203	SCwhn14DY	2014	China	Sichuan	L8
KT945017	HNjz15	2015	China	Henan	L1
KT945018	HNyc15	2015	China	Henan	L3
KU201579	QH-08	2008	China	Qinghai	L8
KU215416	15LY01-FJ	2015	China	Fujian	L8
KU215417	15LY02-FJ	2015	China	Fujian	L8
KU523366	WUH5	2015	China	Hubei	L1
KU523367	WUH6	2011	China	Hubei	L1
KU950370	HENPDS-2	2015	China	Henan	L8
KU950371	HENXC-4	2015	China	Henan	L1
KU950372	HENXX-1	2014	China	Henan	L1
KU950373	HENZK-1	2014	China	Henan	L8
KU950374	HENZMD-9	2015	China	Henan	L1
KU950375	HENZZ-8	2015	China	Henan	L8
KU978619	GD-KP	2015	China	Guangdong	L3
KX169191	FJ1402	2014	China	Fujian	L1
KX357708	QTX	2016	China	na	L8
KX510269	TJnh1501	2015	China	Tianjin	L8
KX621003	GDsg	2015	China	Guangdong	L3
KX650082	RVB-581	2008	China	na	L8
KX689233	XJzx1-2015	2015	China	Xinjiang	L3

KX758249	FJWQ16	2016	China	Fujian	L1
KX758250	FJXS15	2015	China	Fujian	L1
KX766378	HN07-1	2007	China	Hunan	L8
KX766379	HNhx	2016	China	Hunan	L1
KX767091	GSWW/CHA 2015	2015	China	Gansu	L8
KX815407	15GD1	2015	China	Guangdong	L8
KX815408	15GD2	2015	China	Guangdong	L8
KX815409	15GD3	2015	China	Guangdong	L8
KX815410	15GD4	2015	China	Guangdong	L8
KX815411	15HEB1	2015	China	Hebei	L1
KX815412	15HEB3	2015	China	Hebei	L8
KX815413	15HEN1	2015	China	Henan	L1
KX815414	15HEN3	2015	China	Henan	L8
KX815415	15HEN4	2015	China	Henan	L1
KX815416	15HUN1	2015	China	Hunan	L8
KX815417	15HUN2	2015	China	Hunan	L8
KX815418	15HUN3	2015	China	Hunan	L8
KX815419	15JX1	2015	China	Jiangxi	L1
KX815420	15JX2	2015	China	Jiangxi	L8
KX815421	15JX3	2015	China	Jiangxi	L8
KX815422	15JX4	2015	China	Jiangxi	L8
KX815423	15LN1	2015	China	Liaoning	L1
KX815424	15LN2	2015	China	Liaoning	L8
KX815425	15LN3	2015	China	Liaoning	L1
KX815426	15SC1	2015	China	Sichuan	L8
KX815427	15SC2	2015	China	Sichuan	L8
KX815428	15SC3	2015	China	Sichuan	L1
KX815429	15SN1	2015	China	Shannxi	L8
KX815430	15SN2	2015	China	Shannxi	L8
KX815431	15SN3	2015	China	Shannxi	L8
KX815432	15ZJ1	2015	China	Zhejiang	L1
KX815433	15ZJ2	2015	China	Zhejiang	L8
KX815434	15ZJ3	2015	China	Zhejiang	L8
KX900392	HENJY-2	2015	China	Henan	L1
KX980392	SDhz1512	2015	China	Shandong	L1
KX980393	SDlz1601	2016	China	Shandong	L8
KY041782	HENXX-8	2016	China	Henan	L1
KY053458	SDYG1606	2016	China	Shandong	L1
KY290748	HENXX-9	2016	China	Henan	L8
KY373214	JSWA	2014	China	Jiangsu	L1
KY373215	HiNZWQ	2014	China	Hainan	L3
KY373216	AHBZ	2014	China	Anhui	L8
KY373217	SDZZ	2014	China	Shandong	L8

KY373218	SXF105	2014	China	Shanxi	L8
KY412887	FJL15	2014	China	Fujian	L1
KY412888	FJM4	2014	China	Fujian	L1
KY488470	GDJM	2014	China	Guangdong	L8
KY488471	GDGZ	2014	China	Guangdong	L8
KY488472	GDMM	2014	China	Guangdong	L8
KY488473	GDZQ	2014	China	Guangdong	L8
KY488474	HNHK2	2014	China	Hunan	L8
KY488475	HNHK1	2014	China	Hunan	L8
KY488476	GDHY	2015	China	Guangdong	L8
KY488477	GDHZ	2015	China	Guangdong	L8
KY488478	GDQY	2015	China	Guangdong	L8
KY488479	GDSG	na	China	Guangdong	L8
KY495780	JX/CH/2016	2016	China	Jiangxi	L3
KY495781	SH/CH/2016	2016	China	Shanghai	L3
KY498542	GDST	2014	China	Guangdong	L8
KY745901	GDYDZZZ	2016	China	Guangdong	L3
KY761966	FZ16A	2016	China	Fujian	L8
MF124329	GD1404	2014	China	Guangdong	L3
MF196905	SCcd16	2016	China	Sichuan	L3
MF196906	SCnj16	2016	China	Sichuan	L1
MF370557	FZ06A	2006	China	Fujian	L8
MF375260	SD-A19	2015	China	Shandong	L1
MF375261	SC-d	2015	China	Sichuan	L1
MF526896	GDQYQC2	2016	China	Guangdong	L8
MF669720	GD1404	2014	China	Guangdong	L8
MF669721	HZL1501	2015	China	Na	L8
MF669722	ZJXS1412	2014	China	Zhejiang	L8
MF689000	HeN1201	2012	China	Henan	L8
MF766470	HeN1301	2013	China	Henan	L8
MF766471	HeN1401	2014	China	Henan	L1
MF766472	HeN1501	2015	China	Henan	L8
MF766473	HeN1502	2015	China	Henan	L8
MF766474	HeN1601	2016	China	Henan	L1
MF770574	17-ZJ-HZ	2017	China	Zhejiang	L8
MF772778	GDzj	na	China	Guangdong	L8
MF818049	SC/NJ 2016	2016	China	Sichuan	L8
MG011718	FJLIUY-2017	2017	China	Fujian	L3
MG011719	FJDJQ-2017	2017	China	Fujian	L3
MG687491	QHD1	2017	China	Qinghai	L1
MG844181	HB17A	2017	China	Hebei	L1
MG860516	LNWK96	2017	China	Liaoning	L1
MG913987	LNWK130	2017	China	Liaoning	L1

MG914067	SCcd17	2017	China	Sichuan	L1
MH046842	FJNP2017	2017	China	Fujian	L3
MH046843	GDZS2016	2016	China	Guangdong	L3
MH068878	SD17-38	2017	China	Shandong	L1
MH078490	SCN17	2017	China	Sichuan	L1
MH121061	SD17-36	2017	China	Guangdong	L1
MH167387	QHD2	2017	China	Qinghai	L1
MH167388	QHD3	2017	China	Qinghai	L1
MH236426	ZJnb16-2	2016	China	Zhejiang	L3
MH324400	SCya17	2017	China	Sichuan	L3
MH370474	CH/2018/NCV-Anheal-1	2018	China	na	L1
MH404256	SD17	2017	China	Shandong	L8
MH588710	SDbz16-2	2016	China	Shandong	L1
MH651736	CY1-1604	2016	China	na	L1
MH651737	CY2-1604	2016	China	na	L1
MH651738	HNJYF-1606	2016	China	Hunan	L1
MH651739	HBFL-1604	2016	China	Hubei	L1
MH651740	HNJYH-1606	2016	China	Hunan	L1
MH651741	LNCH-1604	2016	China	Liaoning	L1
MH651742	SDQD-1604	2016	China	Shandong	L1
MH651743	SD-1602	2016	China	Shandong	L1
MH651744	SD53-1603	2016	China	Shandong	L1
MH651745	SD99-1606	2016	China	Shandong	L1
MH651746	SDQZ-1609	2016	China	Shandong	L1
MH651747	SDZC-1609	2016	China	Shandong	L8
MH651748	TJZH-1607	2016	China	Tianjin	L1
MH663433	HNRZ	2017	China	Hunan	L8
MK144542	GZgy17	2017	China	Guizhou	L3
MK144543	SCya18	2018	China	Sichuan	L3
MK202794	FJ0908	2018	China	Fujian	L1
MK396376	GDsf1707	2017	China	Guangdong	L1
MK396377	GDsf1710	2017	China	Guangdong	L1
MK396378	GDsf1711	2017	China	Guangdong	L1
MK396379	GDsf1802	2018	China	Guangdong	L1
MK396380	GDsf1804	2018	China	Guangdong	L1
MK396381	GDsf1806	2018	China	Guangdong	L1
MK396382	GDsf1807	2018	China	Guangdong	L1
MK396383	GDsf1808	2018	China	Guangdong	L1
MK396384	GDsf1809	2018	China	Guangdong	L1
MK429980	SWU/MS2/2018	2018	China	Sichuan	L1
MK429981	SWU/MS3/2018	2018	China	Sichuan	L1
MK429982	SWU/MY5/2018	2018	China	Sichuan	L1
MK429983	SWU/MY6/2018	2018	China	Sichuan	L1

MK429984	SWU/YB1/2018	2018	China	Sichuan	L1
MK429985	SWU/YB2/2018	2018	China	Sichuan	L1
MK429986	SWU/CD1/2018	2018	China	Sichuan	L1
MK429987	SWU/CQ1/2018	2018	China	Chongqing	L5
MK450333	CH-WH-2019-1	2018	China	Hubei	L1
MK450365	CH-YY	2018	China	na	L8
MK453049	PRRSV-ZDXYL-China-2018-1	2018	China	Heilongjiang	L1
MK453050	PRRSV-ZDXYL-China-2018-2	2018	China	Heilongjiang	L1
MK759853	XJ17-5	2017	China	Xinjiang	L8
MK780824	SDWH27-1710	2017	China	Shandong	L3
MK780825	SD110-1608	2016	China	Shandong	L3
MK906026	JSTZ1712-12	2017	China	Jiangsu	L8
MN026346	GXBB16-1	2016	China	Guangxi	L8
MN026347	NM-12	na	China	na	L8
MN046221	2014-81	2014	China	Heilongjiang	L8
MN046222	HLJ-80	2016	China	Heilongjiang	L1
MN046223	HLJ-DZD1-1804	2018	China	Heilongjiang	L8
MN046224	HEB-108	2017	China	Hebei	L1
MN046225	Fujian-2014-18	2014	China	Fujian	L1
MN046226	HeNXX-2014-3	2014	China	Henan	L1
MN046227	HeNXX-2014-9	2014	China	Henan	L8
MN046228	HeNXX-2014-12	2014	China	Henan	L1
MN046229	HeB-239	2018	China	Hebei	L1
MN046230	HLJWK108-1711	2018	China	Heilongjiang	L1
MN046231	Anhui-2017-109	2017	China	Anhui	L8
MN046232	JS3-1805	2018	China	Jiangsu	L8
MN046233	Liaoning-2017-6	2017	China	Liaoning	L8
MN046234	SDJM-1602	2016	China	Shandong	L8
MN046235	Gansu-2017-51	2017	China	Gansu	L8
MN046236	Sichuan-2017-117	2017	China	Sichuan	L8
MN046237	InterMo-2015-2	2015	China	Inner Mongolia	L8
MN046238	HN-1603	2016	China	Hunan	L8
MN046239	HLJ-YC8	2018	China	Heilongjiang	L8
MN046240	SX1-1607	2016	China	Shanxi	L1
MN046241	SX2-1607	2016	China	Shanxi	L1
MN046242	LN-DB87	2018	China	Liaoning	L3
MN046243	HLJ-DZD4-1805	2018	China	Heilongjiang	L1
MN119304	SD1612-1	2016	China	Shandong	L8
MN119305	SD1704-23	2017	China	Shandong	L1
MN119306	SH1704-25	2017	China	Shanghai	L8
MN119307	HN1804-2	2018	China	Henan	L1
MN119308	JS1810-195	2018	China	Jiangsu	L8

MN119309	XJ1904-39	2019	China	Xinjiang	L1
MN401750	SW2018001-YL	2018	China	Taiwan	L3
MN547964	JS1703-21	2017	China	Jiangsu	L8
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MN547966	JSTZ1904-664	2019	China	Jiangsu	L8
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MN073156	PRRSV-2017083451-S10	na	USA	na	L8
MN073157	3451R-S10-L001	2018	USA	na	L8
MN073158	2017021039-S12-L001	2017	USA	na	L8
MN073159	lung249621-S5-L001	2017	USA	na	L8
MN073160	lung249622-S6-L001	2017	USA	na	L8

MN073161	9985R-S8-L001	2017	USA	na	L8
MN073162	9981R-S4-L001	2017	USA	na	L8
MN073163	PRR40074-S3-L001	na	USA	na	L8
MN073164	serum24962-S7-L001	2017	USA	na	L8
MN073165	9983R-S6-L001	2017	USA	na	L8
MN073166	PRR80785GJ-S21-L001	na	USA	na	L8
MN073167	PRR80785GD-S22-L001	na	USA	na	L8
MN073168	562482PRRS-S4-L001	2016	USA	na	L8
MN073169	6660R-S5-L001	2017	USA	na	L8
MN073170	9986R-S9-L001	2017	USA	na	L8
MN073171	9987R-S10-L001	2017	USA	na	L8
MN073172	1504R-S1	2018	USA	na	L1
MN073173	8812-3R-S15	2018	USA	na	L1
MN073174	PRRSV-2018017613-S8	2018	USA	na	L1
MN073175	012574PRR-S1-L001	na	USA	na	L1
MN073176	012574VI-S2-L001	na	USA	na	L1
MN073177	191R-S18-L001	2017	USA	na	L1
MN073178	192R-S19-L001	2017	USA	na	L1
MN073179	PRRSVlung-S1-L001	2016	USA	na	L1
MN073180	7703R-S6	2018	USA	na	L1
MN073181	PRR80785	na	USA	na	L8
MN073182	PRR22334-1	na	USA	na	L1
MN175677	PRRSV2/USA/Lab3	2016	USA	na	L1
NC_001961	NC_001961	na	USA	na	L5
U87392	ATCC VR-2332	1992	USA	na	L5
FJ394029	07QN	2007	Viet	na	L8
			Nam		
JX512910	SRV07	2007	Viet	na	L8
			Nam		
KU842720	Hanvet1.vn	2010	Viet	na	L8
			Nam		

Supplementary Table 2. Reference strains information used in this study.

Accession number	Strain	Date	Country	Province/ States	Lineage
AB023782	Kitasato 93-1	na	Japan	na	L4
AB175696	Jiw1	na	Japan	Iwate	L4
AB175708	Jtg1	na	Japan	Tochigi	L4
AB175716	Aomori 93	na	Japan	Aomori	L4
AB175717	Chiba 14	na	Japan	Chiba	L4
AB175720	EDRD-8	na	Japan	Hokkaido	L4
AB175721	Gu922M	na	Japan	Gunma	L4
AB175722	Ibaraki 3	na	Japan	Ibaraki	L4
AB175712	Jyt1	na	Japan	Yamagata	L4
AB175714	Jyt3	na	Japan	Yamagata	L4
AF176462	PRRSV40	na	USA	Illinois	L9
DQ475064	PRRSV0000386	2004	na	na	L9
DQ476027	PRRSV0001584	2003	USA	Nebraska	L9
DQ476294	PRRSV0001940	2003	USA	Texas	L9
DQ476464	PRRSV0002160	2003	USA	North Carolina	L9
DQ477194	PRRSV0003049	2004	USA	Texas	L9
DQ477476	PRRSV0003401	na	na	na	L9
EU556160	2000-5424	na	na	na	L9
EU756048	PRRSV0000004469	2005	USA	Minnesota	L9
EU756993	PRRSV0000006345	2001	USA	Iowa	L9
EU757947	PRRSV0000007649	2005	USA	Iowa	L9
EU758266	PRRSV0000008140	2005	USA	Iowa	L9
JX014352	XJNJ-2-2	2011	China	Xinjiang	L9
JX014359	XJNJ-17-2	2011	China	Xinjiang	L9

Supplementary Table3. Recombination information of PRRSVs in 2019-2021.

Accession number	Strain name	Country	Major parent	Minor parent	Region 1			Region 2			Region 3			Region 4		
					Left	Right	Length	Left	Right	Length	Left	Right	Length	Left	Right	Length
MK429986	SWU/CD1/2018	China	L1	L5	7871	8111	240	12849	13296	447						
MK429985	SWU/YB2/2018	China	L1	L5	7931	8126	195	12847	13311	464						
MK429984	SWU/YB1/2018	China	L1	L5	7871	8111	240	12849	13301	452						
MK429983	SWU/MY6/2018	China	L1	L5	7890	8109	219	12840	13301	461						
MK429982	SWU/MY5/2018	China	L1	L5	7890	8109	219	12840	13301	461						
MK429981	SWU/MS3/2018	China	L1	L5	7871	8111	240	12829	13315	486						
MK429980	SWU/MS2/2018	China	L1	L5	7911	8111	200	12847	13301	454						
MK144543	SCya18	China	L1	L8	1	1685	1684	11093	11600	507	12001	12270	269	12468	14171	1703
MH588710	SDbz16-2	China	L1	L8	5414	6949	1535									
MF766472	HeN1501	China	L8	L5	12525	12875	350									
MN606304	JS18-3	China	L8	L1	1799	5019	3220									
MN660070	GXNN1839	China	L1	L5	7911	8113	202	12844	13300	456						
MN660067	GXNN1396-p3	China	L8	L9	12916	13141	225									
MK780825	SD110-1608	China	L8	L3	3889	6738	2849	11329	13067	1738	13792	15211	1419			
MK396384	GDsf1809	China	L1	L5	7842	8111	269	12890	13277	387						
MK396383	GDsf1808	China	L1	L5	7836	8117	281	12890	13285	395						
MK396382	GDsf1807	China	L1	L5	7835	8129	294	12898	13296	398						
MK396381	GDsf1806	China	L1	L5	7842	8117	275	12890	13285	395						
MK396380	GDsf1804	China	L1	L5	7842	8117	275									
MK396379	GDsf1802	China	L1	L8	6960	7441	481	7871	8752	881						
MK396378	GDsf1711	China	L1	L8	6954	7437	483	7851	8752	901						
MK396377	GDsf1710	China	L1	L8	6954	7437	483	7871	8752	881						
MK396376	GDsf1707	China	L1	L8	6954	7437	483	7871	8752	881						
	HB94-lun	China	L1	L8	5496	8132	2636									
	S145	China	L1	L5	7971	8104	133									
	S130-lym	China	L1	L5	7874	8104	230									
	C101-lun	China	L8	L5	12451	12634	183	12901	15898	2997						
	S039	China	L8	L1	1814	5772	3958	13827	14984	1157						
	H60-lun	China	L1	L8	1	2030	2029	5415	8173	2758						

	NA80-lun	China	L5	L8	1235	1495	260	2266	4401	2135	5809	6687	878	9093	12534	3441
	LN86-lun	China	L1	L5	11088	11661	573									
	H013	China	L1	L8	5901	6201	300	7122	8121	999						
	S043	China	L1	L8	1	1551	1550	5402	8151	2749						
	S136-lun	China	L1	L8	5940	6317	377	6761	8118	1357						
	H012	China	L1	L8	1	2025	2024	5504	9168	3664	14011	14251	240			
	S001-lun	China	L1	L5	7871	8116	245	12824	13308	484						
MF526896	GDQYQC2	China	L8	L3	11328	13843	2515	14568	15081	513						
MN119308	JS1810-195	China	L8	L6	4301	4451	150	5361	5560	199	12071	13041	970			
MN119309	XJ1904-39	China	L8	L1	2122	5756	3634	12281	15012	2731						
MN642099	SDqd1501	China	L8	L3	3899	6760	2861	11336	13105	1769	13827	15172	1345			
MN642102	SDwh1601	China	L8	L1	12344	12547	203	12836	15315	2479						
MN642105	SDyt1401	China	L8	L1	12312	12521	209	12820	15315	2495						
MT394494	GDhh1808	China	L8	L1	1569	5415	3846	12317	13866	1549	14319	15046	727			
MT416541	PRRSV2/CN/X2984/2018	China	L8	L5	8910	9590	680	13148	13357	209						
MT416542	PRRSV2/CN/N9185/2018	China	L8	L1	12021	14033	2012	14191	14600	409						
MT416543	PRRSV2/CN/F1228/2017	China	L8	L5	1972	2189	217									
MT708500	SD-YL1712	China	L8	L1	2145	4072	1927									
MT721741	PRRSV2/CN/GDDX/2018	China	L8	L5	8770	9590	820	13148	13357	209						
MZ579701	HBap4/2018	China	L8	L1	2030	5673	3643	6857	7921	1064	14848	15028	180			
MH651745	SD99-1606	China	L1	L5	7881	8121	240									
MN119305	SD1704-23	China	L1	L8	6798	7416	618	12880	13253	373						
MN119307	HN1804-2	China	L1	L8	5522	8141	2619									
MN642101	SDwh1403	China	L1	L5	7881	8127	246	12851	13331	480						
MN862433	FJDJQ-2018	China	L1	L8	1	1294	1293	4236	6394	2158	7259	9668	2409			
MT036897	FS-GD-02_FoShan_Guangdong_2016.01	China	L1	L8	6775	9794	3019	11081	11345	264						
MT036898	GDHZ_Huizhou	China	L1	L8	11348	11701	353									
MT036899	HZ1-3_Yunnan_20171	China	L1	L8	429	683	254									
MT075480	SC/DJY	China	L1	L8	7868	8944	1076	11095	11561	466	11864	12343	479			
MT165636	GD1909	China	L1	L8	1	1303	1302	4395	5984	1589	7821	8134	313			
MT394496	GDsc1808	China	L1	L5	7842	8121	279	12890	13285	395						
MT394497	GDsc1809	China	L1	L5	7842	8117	275	12893	13285	392						
MT409687	PRRSV2/CN/X4831/2018	China	L1	L8	6933	7451	518	7868	8251	383						
MT409688	PRRSV2/CN/X9830/2018	China	L1	L8	185	701	516	12788	13418	630	14241	14396	155			

MT409689	PRRSV2/CN/X4836/2018	China	L1	L8	6888	9516	2628	12486	12914	428	13113	13471	358			
MT409691	PRRSV2/CN/X4833/2018	China	L1	L8	1	1046	1045	12850	13007	157	13189	13418	229			
MT409692	PRRSV2/CN/X4839/2017	China	L1	L8	4855	5121	266									
MT416546	PRRSV2/CN/110713/2018	China	L1	L8	431	716	285	6945	7366	421	8291	8497	206			
MW531679	GXNN202004a	China	L1	L8	1	446	445	5721	6902	1181						
MW561594	GXNN202004	China	L1	L8	1	2024	2023	5812	8964	3152	11356	11561	205			
MW803134	PRRSV-China/SCcd2020/2020	China	L1	L8	4085	4594	509	5438	8149	2711	8774	8957	183	12661	13229	568
MZ342900	JS2020	China	L1	L8	5445	8239	2794	12728	13000	272	14323	14525	202			

Supplementary Table 4. Primers used to construct the HuN4 and HeB108 recombinant viruses.

Primer name	Primer Sequence (5'-3')
HeB- <i>Nhe</i> -F	AGGAACAGTGTTTAAACTGCTAGCCGCCAGCGGCTTGAC
HeB- <i>Nhe</i> -R	GTCAAGCCGCTGGCGGCTAGCAGTTTAAACACTGTTTCCT
HeB-HuN-F	CTCAGGTCCAATCATGAGGGGAAGAAGTCCAGGGTG
HeB-HuN-R	CACCCTGGACTTCTTCCCCTCATGATTGGACCTGAG
HeB-HuNp-F	GCTGTGCGAGAAAACACTGGCAGACTGTTACCCCTTGC
HeB- HuNp-R	GCAAGGGGTAACAGTCTGCCAGTTTTCTCGCACAGC
HuN-HeB-F	CTCAGGTCCAATTATGAAGGGGAAGAAGTCCAGAATG
HuN-HeB-R	CATTCTGGACTTCTTCCCCTCATAATTGGACCTGAG
HuN- <i>Nhe</i> -F	AGGAGCAGTGTTTAAACTGCTAGCCGCCAGCGGCTTG
HeB- <i>Asc</i> -R	TTTCCCTTTCTGGCGCGCCCGAAACGCATCATTGTAAT
HuN-HeBp-F	GCTGTGCGAGAAAACACTGGCAAACACTGTTACCCCTTGT
HuN-HeBp-R	ACAAGGGGTAACAGTTTGCCAGTTTTCTCGCACAGC