Supporting Information.

**Characterization of a New *Chlorovirus* Type with Permissive and Non-permissive Features on Phylogenetically Related Algal Strains**

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**Glycopeptide isolation and chemical composition.**

*Glycopeptide isolation*

The major capsid protein was isolated, protease digested and the glycopeptide purified as described previously (De Castro et al., 2013). Monosaccharide absolute configuration D for all residues, but fucose, was determined by preparing the fully acetylated 2-(-)-octyl derivatives as reported for PBCV-1 (De Castro et al., 2013).In order to determine the absolute configuration of the 3 O Me-xylose, the acetylated octylglycoside mixture was methylated following the procedure described for virus NY-2A (De Castro et al., 2016). Also in this case, the xylose was D configured.

*NMR spectroscopy*

NMR experiments were recorded in D2O at 310 K on a Bruker DRX-600 instrument equipped with a cryo-probe. Homonuclear experiments were recorded using 512 FIDs of 2048 complex with 40 scans per FID and mixing time of 100 ms and 300 ms were used for TOCSY and T-ROESY spectra acquisition, respectively. Heteronuclear experiments (HSQC, HMBC and HSQC-TOCSY) were acquired with 512-256-240 FIDs of 2018 complex point with 60-120-200 scans for FID, respectively. The mixing time of 80 ms was used for HSQC-TOCSY spectrum. Standard Bruker software (Topspin 3.1) was used for process and analysis of all spectra.

*NMR characterization*

The 1H-NMR spectrum (projection in Sup. Fig. 1, chemical shift values in Sup. Table 4) showed six signals in the anomeric region from 5.7 to 4.4 ppm, that were labeled with a letter **A** to **F** in order of their decreasing chemical shift, a carbinolic region (from 4.3 to 3.10 ppm) containing one O-Me signal at 3.63 ppm and two methyl signals at around 1.3 ppm, typical of 6-deoxyresidues. Inspection of the HSQC spectrum (Sup. Fig. 1, Sup. Table 4) disclosed that the **D** was *N*-linked to the protein due to its carbon chemical shift at 80.7 ppm, and its pattern in the TOCSY spectrum was consistent with the *gluco* stereochemistry. Integrating TOCSY information with those from the other spectra (COSY and HSQC) identified this residue as a beta-glucose, substituted at both O3 and O4, similarly to what was reported for the PBCV-1 glycopeptide (De Castro et al., 2013). The same approach was used to identify all other residues.

Regarding **A**, TOCSY experiment displayed a correlation from the anomeric proton (5.63 ppm) with H-2, H-3 and H-4, furthermore COSY spectrum did not display any intense correlation between H-3 and H-4, as typically occurs for *galacto* configured residue. T-ROESY experiment (Sup. Fig. 2) was used to determine the position of H-5 proton that was in turn correlated with a methyl group at 1.30 ppm. Thus, A was an alpha-fucose residue, and the low field values of the carbon C-2, C-3 and C-4 with respect to standard values determined that it was fully substituted as in PBCV-1. The spectroscopic pattern of **B** was very similar to that of **A**, with the difference that H-6 of **B** correlated with a carbon at 62.3 ppm, thus it was a galactose unit, not further substituted and α configured at the anomeric center on the basis of the carbon chemical shift values determined.

With regard to **C**, its anomeric proton displayed only one COSY and TOCSY correlation (H-1/H-2), whereas the connections up to the H-6 (a methyl group) were visible from H-2: this information coupled to HSQC spectrum, identified E as a terminal rhamnose. The spectroscopic pattern of **E** was similar to that of **F** and the efficient propagation of the magnetization in the TOCSY spectrum identified them as two beta-xylose units. Of note, H-3 of **F** resonated at (1H/13C) 3.23/86.8 ppm suggesting that this position was *O*-methylated as confirmed by the corresponding HMBC and T-ROESY correlations. Moreover, the T-ROESY experiment (Sup. Fig. 2) revealed that **E** was linked at *O*-4 of **A**, while **F** at *O*-4 of **D**. These two units take also the name distal and proximal, respectively, owing to the different distance from the N-glycosylation site.

Completion of the OSy-NE5 glycopeptide structure was inferred by analyzing the T-ROESY spectrum (Sup. Fig. 2), which disclosed that **A** was linked at *O*-3 of **D** and in turn had **B** at *O*-2, **C** at *O*-3 and **E** at *O*-4. Combining NMR information with those from absolute configuration permitted the construction of the structure of the glycan as depicted in Fig. 4B.

**References**

De Castro C, Molinaro A, Piacente F, Gurnon JR, Sturiale L, Palmigiano A, Lanzetta R, Parrilli M, Garozzo D, Tonetti M, Van Etten JL *PNAS.* **2013,** *110*, 13956-13960. Doi: 10.1073/pnas.1313005110.

De Castro C, Speciale I, Duncan G, Dunigan DD, Agarkova I, Lanzetta R, Sturiale L, Palmigiano A, Garozzo D, Molinaro A, Tonetti M, Van Etten JL *Angew. Chem. Int. Ed.* **2016**, 55, 654-65

**Sup. Table 1.** Annotation of the OSy-NE5 genome

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CDS** | **start** | **end** | **ORF length** | **Putative activity** | **PBCV-1 gene tag (or other Chlorovirus) of Osy-NE5 homolog** | **NCBI RefSeq/GenBank Accesion Number: NC64A\_PBCV-1 Sequence ID or other Chlorovirus** | **Cluster ID** | **#PBCV-1 homolog is active** |
| OS5\_001L | 478 | 1044 | 188 | hypothetical protein | SAG3.83\_TN603.4.2\_002L | AGE59612.1 | CL0468 |  |
| OS5\_002L | 1898 | 2083 | 61 |  | a004L |  | CL0757 |  |
| OS5\_003R | 2693 | 3874 | 393 | hypothetical protein, many Glu, Asp, and Glys | NSSF |  | n/d |  |
| OS5\_004R | 3950 | 4876 | 308 | Ser/Thr protein kinase | A034R | NP\_048382.1 | CN0002 | yes |
| OS5\_005L | 4881 | 6590 | 569 | DNA binding protein | A035L | NP\_048383.2 | CL0822 |  |
| OS5\_006L | 6610 | 6924 | 104 | hypothetical protein | A037L | NP\_048385.1 | CL0002 |  |
| OS5\_007L | 6964 | 7410 | 148 | SKP1-like protein | A039L | NP\_048387.1 | n/d | yes |
| OS5\_008R | 7537 | 8742 | 401 | hypothetical protein | A041R | NP\_048389.1 | CL0511 |  |
| OS5\_009L | 8739 | 10574 | 611 | AAA ATPase | A044L | NP\_048392.1 | CL0262 |  |
| OS5\_010R | 10642 | 11019 | 125 | hypothetical protein | A048R | NP\_048396.1 | CL0274 |  |
| OS5\_011L | 11016 | 11645 | 209 | Glycerophosphoryl diesterase phosphodiesterase | A049L | NP\_048397.1 | CL0285 |  |
| OS5\_012L | 11692 | 12117 | 141 |  | A050L |  | CN0039 |  |
| OS5\_013R | 12221 | 12349 | 42 | hypothetical protein | A050aL | YP\_004678878.1 | n/d |  |
| OS5\_014L | 12337 | 13146 | 269 | Aquaglyceroporin | Pbi\_OR0704.2.2\_056R | AGE58959.1 | CL0466 | yes |
| OS5\_015R | 13282 | 14370 | 362 | D-lactate dehydrogenase | A053R | NP\_048401.1 | CL0334 |  |
| OS5\_016L | 14558 | 14758 | 66 | ribonuclease E | NC64A\_IL-5-2s1\_196R | AGE54132.1 | CL0535 |  |
| OS5\_017L | 14822 | 15877 | 351 | Glycosyltransferase domain, GTB type | A659L | NP\_049015.2 | CL0446 |  |
| OS5\_018R | 15974 | 17461 | 495 | hypothetical protein, IgGFc-binding protein, Pro, Lys rich | A057aR | YP\_004678879.1 | CL0898 |  |
| OS5\_019R | 17494 | 18237 | 247 | Methyltransferase FkbM family | NC64A\_CvsA1\_020R | AGE52378.1 | CL0071 |  |
| OS5\_020L | 18334 | 18960 | 208 | hypothetical protein | A437aR | YP\_004678954.1 | n/d |  |
| OS5\_021R | 19035 | 19946 | 303 | hypothetical protein | NC64A\_CvsA1\_025R | AGE52380.1 | CL0063 |  |
| OS5\_022R | 19971 | 20762 | 263 | hypothetical protein | NC64A\_CvsA1\_027R | AGE52381.1 | CL0537 |  |
| OS5\_023R | 20878 | 21855 | 325 | hypothetical protein | A067R | NP\_048415.1 | CL0530 |  |
| OS5\_024R | 21888 | 22952 | 354 | hypothetical protein | A071R | NP\_048419.1 | CN0017 |  |
| OS5\_025L | 22962 | 23801 | 279 | Exostosin | A075L | NP\_048423.1 | CL0413 |  |
| OS5\_026L | 24085 | 24354 | 89 | No hits to anything | NSSF |  | n/d |  |
| OS5\_027L | 24418 | 24693 | 91 | hypothetical protein | A076L | NP\_048424.1 | CL0590 |  |
| OS5\_028L | 24686 | 24964 | 92 | hypothetical protein | A077L | NP\_048425.1 | CL0430 |  |
| OS5\_029R | 25083 | 25979 | 298 | N-carbamoylputrescine amidase | A078R | NP\_048426.1 | CL0441 | yes |
| OS5\_030R | 26750 | 27478 | 242 | hypothetical protein | A079R | NP\_048427.2 | n/d |  |
| OS5\_031L | 27482 | 28051 | 189 | hypothetical protein | A081L | NP\_048429.1 | n/d |  |
| OS5\_032L | 28124 | 28654 | 176 | hypothetical protein | A084L | NP\_048432.1 | CL0472 |  |
| OS5\_033R | 28800 | 29480 | 226 | Prolyl 4-hydroxylase | A085R | NP\_048433.1 | CL0483 | yes |
| OS5\_034R | 29529 | 30443 | 304 | hypothetical protein | A088R | NP\_048436.1 | CL0342 |  |
| OS5\_035R | 30553 | 31041 | 162 | hypothetical protein | A088R | NP\_048436.1 | CL0342 |  |
| OS5\_036L | 31123 | 32424 | 433 | PBCV-specific basic adaptor domain-containing protein | A092/093L | NP\_048441.3 | CN0002 |  |
| OS5\_037L | 32462 | 33562 | 366 | Beta 1,3-glucanase | A094L | NP\_048442.1 | CL0520 | yes |
| OS5\_038R | 33716 | 35407 | 563 | Hyaluronan synthase | A098R | NP\_048446.1 | CL0902 | yes |
| OS5\_039R | 35562 | 37349 | 595 | Glucosamine--fructose-6-phosphate aminotransferase | A100R | NP\_048448.2 | CL0534 | yes |
| OS5\_040R | 37518 | 38510 | 330 | mRNA-capping enzyme (mRNA guanylyltransferase) | A103R | NP\_048451.1 | n/d | yes |
| OS5\_041L | 38497 | 39315 | 272 | Ubiquitin carboxyl-terminal hydrolase | A105L | NP\_048453.1 | CL0551 |  |
| OS5\_042L | 39404 | 40276 | 290 | Transcription factor IIB | A107L | NP\_048455.1 | CL0559 |  |
| OS5\_043L | 40378 | 40863 | 161 | GIY-YIG catalytic domain-containing endonuclease | A108bL | NP\_048457.2 | CL0566 |  |
| OS5\_044R | 40988 | 43570 | 860 | Glycosyl transferase | A111/114R | NP\_048459.2 | CL0569 |  |
| OS5\_045R | 43618 | 44658 | 346 | GDP-D-mannose dehydratase | A118R | NP\_048466.1 | CL0577 | yes |
| OS5\_046R | 44678 | 44992 | 104 | Tir Gfp DNA mobile protein | A121R | NP\_048469.2 | CL0584 |  |
| OS5\_047R | 45042 | 48848 | 1268 | hypothetical glycoprotein | A122/123R | NP\_048471.2 | CL0231 |  |
| OS5\_048L | 48850 | 49392 | 180 | Transcription factor IIS | A125L | NP\_048472.1 | CL0603 |  |
| OS5\_049R | 49426 | 50142 | 238 | hypothetical protein | A127R | NP\_048475.1 | CL0611 |  |
| OS5\_050R | 50214 | 51368 | 384 | hypothetical protein | A154L | NP\_048502.1 | n/d |  |
| OS5\_051R | 51388 | 51705 | 105 | hypothetical protein | A130R | NP\_048478.1 | n/d |  |
| OS5\_052L | 51698 | 52105 | 135 | hypothetical protein | A131L | NP\_048479.1 | CL0619 |  |
| OS5\_053L | 52246 | 52764 | 172 | GIY-YIG catalytic domain-containing endonuclease | A134L | NP\_048482.1 | n/d |  |
| OS5\_054R | 52810 | 53250 | 146 | hypothetical protein | A136R | NP\_048484.1 | CL0633 |  |
| OS5\_055R | 53326 | 53532 | 68 | hypothetical protein | A137R | NP\_048485.1 | CL0540 |  |
| OS5\_056R | 53578 | 54384 | 268 | hypothetical protein | A138R | NP\_048486.1 | n/d |  |
| OS5\_057L | 54381 | 54692 | 103 | hypothetical protein | A139L | NP\_048487.2 | CL0641 |  |
| OS5\_058R | 54770 | 58264 | 1164 | hypothetical protein, surface protein? | A140/145R | NP\_048488.3 | CN0001 |  |
| OS5\_059L | 58650 | 59090 | 146 | hypothetical protein | A150L | NP\_048498.1 | CL0659 |  |
| OS5\_060R | 59204 | 60580 | 458 | ATP-dependent RNA helicase | A153R | NP\_048501.1 | CL0676 |  |
| OS5\_061L | 60583 | 61395 | 270 | GIY-YIG catalytic domain-containing endonuclease | A315L | NP\_048671.1 | n/d |  |
| OS5\_062L | 61476 | 61814 | 112 | hypothetical protein | A157L | NP\_048505.1 | CL0686 |  |
| OS5\_063L | 61862 | 62182 | 106 | hypothetical protein | A158L | NP\_048506.1 | CL0688 |  |
| OS5\_064R | 62338 | 62775 | 145 | hypothetical protein | A161R | NP\_048509.1 | CL0786 |  |
| OS5\_065L | 62776 | 63996 | 406 | hypothetical protein, PBCV-1, ?glutamate receptor | A162L | NP\_048510.1 | n/d |  |
| OS5\_066R | 64037 | 65383 | 448 | Ligand-gated ion channel | A163R | NP\_048511.2 | CL0699 |  |
| OS5\_067R | 65408 | 65584 | 58 | hypothetical protein | A164aR | YP\_004678903.1 | CL0708 |  |
| OS5\_068L | 65610 | 65948 | 112 | hypothetical protein | A165L | NP\_048513.2 | CL0712 |  |
| OS5\_069L | 65979 | 66440 | 153 | hypothetical protein | A165aL | YP\_004678904.1 | n/d |  |
| OS5\_070R | 66503 | 67309 | 268 | ygaJ-like virus recombinase | A166R | NP\_048514.2 | CL0724 |  |
| OS5\_071R | 67348 | 67845 | 165 | hypothetical protein | A168R | NP\_048516.1 | CL0733 |  |
| OS5\_072R | 67957 | 68928 | 323 | Aspartate carbamoyltransferase | A169R | NP\_048517.1 | CL0739 | yes |
| OS5\_073R | 68959 | 70134 | 391 | hypothetical protein | A171R | NP\_048519.1 | CL0511 |  |
| OS5\_074L | 70137 | 70964 | 275 | Patatin-like phospholipase | A173L | NP\_048521.1 | CL0752 |  |
| OS5\_075L | 71085 | 71294 | 69 | PBCV-specific basic adaptor domain-containing protein | A176L | NP\_048524.1 | CN0002 |  |
| OS5\_076L | 71315 | 71617 | 100 | PBCV-specific basic adaptor domain-containing protein | A176L | NP\_048524.1 | CN0002 |  |
| OS5\_077R | 72123 | 72860 | 245 | hypothetical protein | A177R | NP\_048525.1 | n/d |  |
| OS5\_078R | 72948 | 73820 | 290 | Zn-finger containing protein? | A478L | NP\_048834.1 | n/d |  |
| OS5\_079L | 73815 | 74099 | 94 | Potassium ion channel protein | A250R | NP\_048599.1 | CN0009 | yes |
| OS5\_080L | 74122 | 74988 | 288 | Calcium/calmodulin dependent protein kinase type 1G | A248R | NP\_048597.1 | n/d | yes |
| OS5\_081R | 75204 | 78062 | 952 | Chlorovirus glycoprotein repeat domain-containing protein | A122/123R | NP\_048471.2 | CL0231 |  |
| OS5\_082R | 78104 | 82468 | 1454 | Chlorovirus glycoprotein repeat domain-containing protein | A122/123R | NP\_048471.2 | CL0231 |  |
| OS5\_083R | 82497 | 86882 | 1461 | Ser/Thr-protein phosphatase, 6 regulatory ankyrin repeats | A025/027/029L | NP\_048355.2 | n/d |  |
| OS5\_084R | 86897 | 91348 | 1483 | Chlorovirus glycoprotein repeat domain-containing protein | A025/027/029L | NP\_048373.2 | n/d |  |
| OS5\_085R | 91445 | 95965 | 1506 | Chlorovirus glycoprotein repeat domain-containing protein | A122/123R | NP\_048471.2 | CL0231 |  |
| OS5\_086R | 96011 | 97246 | 411 | Major capsid protein Vp54 (I) | A430L (weak match) | NP\_048787.1 | n/d |  |
| OS5\_087L | 97259 | 98143 | 294 | Chitin binding domain-containing protein, many PAPK repeats | A246aR | NP\_048594.2 | CN0022 |  |
| OS5\_088L | 98171 | 100348 | 725 | DEAD/DEAH box II RNA helicase | A241R | NP\_048589.1 | CL0122 |  |
| OS5\_089R | 100512 | 100949 | 145 | hypothetical protein | A239L | NP\_048587.2 | CL0113 |  |
| OS5\_090L | 100954 | 102504 | 516 | Homospermidine synthase | A237R | NP\_048585.1 | CL0111 | yes |
| OS5\_091R | 102577 | 102903 | 108 | hypothetical protein | A234L | NP\_048582.1 | CL0105 |  |
| OS5\_092L | 102900 | 103223 | 107 | hypothetical protein | A233R | NP\_048581.1 | CL0103 |  |
| OS5\_093R | 103273 | 104412 | 379 | hypothetical protein | A231L | NP\_048579.1 | CN0012 |  |
| OS5\_094L | 104426 | 105016 | 196 | hypothetical protein | A230R | NP\_048578.1 | CL0085 |  |
| OS5\_095R | 105041 | 105274 | 77 | hypothetical protein | A229L | NP\_048577.1 | n/d |  |
| OS5\_096R | 105296 | 105709 | 137 | hypothetical protein | A227L | NP\_048575.1 | CL0079 |  |
| OS5\_097L | 105718 | 107613 | 631 | Cellulose synthase catalytic subunit (UDP-forming) or N-acetylglucosaminyl transferase | A219/222/226R | NP\_048569.4 | CL0775 |  |
| OS5\_098R | 107723 | 108877 | 384 | Amine oxidase | A217L | NP\_048564.1 | CL0058 |  |
| OS5\_099R | 108897 | 109832 | 311 | Alginate lyase | A215L | NP\_048562.2 | CN0001 | yes |
| OS5\_100L | 110285 | 111085 | 266 | GIY-YIG catalytic domain-containing endonuclease | A495R | NP\_048851.1 | n/d |  |
| OS5\_101R | 111222 | 111641 | 139 | hypothetical protein | A214L | NP\_048561.1 | n/d |  |
| OS5\_102R | 111682 | 112128 | 148 | hypothetical protein | A213L | NP\_048560.1 | CL0030 |  |
| OS5\_103L | 112125 | 112301 | 58 | Hypothetical protein | A212R | NP\_048559.2 | CL0073 |  |
| OS5\_104L | 112325 | 113197 | 290 | hypothetical protein | A208R | NP\_048555.2 | CL0793 |  |
| OS5\_105L | 113325 | 114443 | 372 | Arginine/ornithine decarboxylase | A207R | NP\_048554.1 | CL0013 | yes |
| OS5\_106L | 114506 | 115033 | 175 | PBCV-specific basic adaptor domain-containing protein | A205R | NP\_048552.1 | CL0003 |  |
| OS5\_107L | 115175 | 115819 | 214 | hypothetical protein | A203R | NP\_048550.1 | CL0907 |  |
| OS5\_108R | 115885 | 116226 | 113 | hypothetical protein | A202L | NP\_048549.1 | CL0897 |  |
| OS5\_109R | 116245 | 116529 | 94 | hypothetical protein | A201L | NP\_048548.1 | CL0886 |  |
| OS5\_110L | 116552 | 116908 | 118 | Cytidine and deoxycytidylate deaminase | A200R | NP\_048547.1 | CL0877 |  |
| OS5\_111L | 117010 | 117312 | 100 | hypothetical protein | A199R | NP\_048546.1 | n/d |  |
| OS5\_112R | 117360 | 117818 | 152 | hypothetical protein | A196L | NP\_048543.1 | CL0463 |  |
| OS5\_113R | 117823 | 118629 | 268 | PCNA | A193L | NP\_048540.1 | n/d |  |
| OS5\_114L | 118632 | 122762 | 1376 | SWI/SNF chromatin remodeling complex? | A189/192R | NP\_048536.3 | CN0029 |  |
| OS5\_115L | 122805 | 123501 | 232 | DNA polymerase | A185R | NP\_048532.2 | CN0021 |  |
| OS5\_115L | 123601 | 125644 | 681 | DNA polymerase | A185R | NP\_048532.2 | CN0021 |  |
| OS5\_116R | 125720 | 125947 | 75 | hypothetical protein, no hits to anything | NSSF |  | n/d |  |
| OS5\_117L | 126119 | 127696 | 525 | Chitinase | A181/182R | NP\_048529.2 | CL0887 | yes |
| OS5\_118R | 128104 | 128553 | 149 | Hypothetical protein | A253R | NP\_048604.1 | CL0165 |  |
| OS5\_119R | 128584 | 130101 | 505 | Chitinase | A260R | NP\_048613.3 | n/d | yes |
| OS5\_120R | 130135 | 130683 | 182 | Chloramphenicol acetyltransferase | NC64A\_CviKI\_281R | AGE51474.1 | CL0462 |  |
| OS5\_121L | 130667 | 131422 | 251 | GIY-YIG catalytic domain-containin endonuclease | NC64A\_NY2A\_B389R | YP\_001497585.1 | CN0005 |  |
| OS5\_122L | 131487 | 132137 | 216 | hypothetical protein | A262/263L | NP\_048617.2 | n/d |  |
| OS5\_123L | 132158 | 132907 | 249 | Poxvirus A22-like protein | A265L | NP\_048619.2 | n/d |  |
| OS5\_124L | 132921 | 133157 | 78 | hypothetical protein | A273L | NP\_048627.1 | CN0036 |  |
| OS5\_125L | 133217 | 134389 | 390 | hypothetical protein | unclassified-chlorovirus\_CV-XZ6E | S26850 | n/d |  |
| OS5\_126R | 134530 | 135663 | 377 | DNA adenine methyltransferase | NC64A\_NY-2B\_261L | AGE58281.1 | CN0030 | yes |
| OS5\_127R | 135696 | 137411 | 571 | hypothetical protein, no hits [possible restriction endonuclease?] | NSSF |  | n/d |  |
| OS5\_128R | 137433 | 138548 | 371 | DNA adenine methyltransferase | Pbi\_CVB-1\_012R | AGE50697.1 | CN0030 | yes |
| OS5\_129R | 138579 | 139757 | 392 | DNA adenine methyltransferase | NC64A\_NY2A\_B230L | YP\_001497426.1 | CN0030 | yes |
| OS5\_130R | 139853 | 140869 | 338 | hypothetical protein | A328L | NP\_048684.1 | CL0283 |  |
| OS5\_131R | 140999 | 141577 | 192 | protein of unknown function (DUF1390) | A647R | NP\_049003.1 | n/d |  |
| OS5\_132R | 141778 | 142521 | 247 | hypothetical protein | A275R | NP\_048629.1 | n/d |  |
| OS5\_133L | 142506 | 143345 | 279 | Ser/Thr-protein kinase | A277L | NP\_048631.1 | CN0015 | yes |
| OS5\_134L | 143421 | 145166 | 581 | protein kinase, PBCV-1-specific basic adaptor domain-containing protein | A278L | NP\_048632.2 | CN0002 |  |
| OS5\_135L | 145323 | 146162 | 279 | Amidase | A284L | NP\_048638.1 | CL0240 |  |
| OS5\_136R | 146229 | 147335 | 368 | hypothetical protein | A286R | NP\_048640.1 | CL0250 |  |
| OS5\_137L | 147389 | 148243 | 284 | Ser/Thr protein kinase | A289L | NP\_048643.1 | CL0780 | yes |
| OS5\_138L | 148329 | 149342 | 337 | Chitosanase | A292L | NP\_048646.1 | CL0264 | yes |
| OS5\_139L | 149354 | 150292 | 312 | GDP-L-fucose synthase 2 | A295L | NP\_048649.2 | n/d | yes |
| OS5\_140L | 150323 | 150568 | 81 | No homologs | NSSF |  | n/d |  |
| OS5\_141R | 150567 | 150821 | 84 | hypothetical protein | A296R | NP\_048650.2 | n/d |  |
| OS5\_142L | 150856 | 151806 | 316 | Fibernectin binding protein | NC64A\_CviKI\_028L | AGE51367.1 | CL0531 |  |
| OS5\_143R | 151960 | 152883 | 307 | hypothetical protein | A067R | NP\_048415.1 | CL0530 |  |
| OS5\_144L | 152921 | 153445 | 174 | Phosphoglycerate mutase | A297L | NP\_048651.1 | CL0265 |  |
| OS5\_145R | 153565 | 154026 | 153 | hypothetical protein | NC64A\_NE-JV-4\_441L | AGE57332.1 | CL0235 |  |
| OS5\_146L | 154050 | 154724 | 224 | hypothetical protein | A298L | NP\_048652.1 | CL0266 |  |
| OS5\_147L | 154745 | 155479 | 244 | hypothetical protein | A301L | NP\_048655.1 | n/d |  |
| OS5\_148R | 155534 | 155770 | 78 | hypothetical protein | A304R | NP\_048658.1 | CL0268 |  |
| OS5\_149L | 155811 | 156425 | 204 | Dual specificity protein phosphatase 16 / mitogen | A305L | NP\_048659.1 | CL0269 |  |
| OS5\_150L | 156450 | 156710 | 86 | hypothetical protein | A306L | NP\_048660.1 | CL0488 |  |
| OS5\_151L | 156747 | 157100 | 117 | hypothetical protein | A308L | NP\_048663.2 | CL0270 |  |
| OS5\_152L | 157229 | 157561 | 110 | Fibernectin-binding protein | A180R | NP\_048528.1 | CL0794 |  |
| OS5\_153L | 157624 | 158136 | 170 | hypothetical protein | A310L | NP\_048665.1 | CL0272 |  |
| OS5\_154L | 158204 | 158920 | 238 | hypothetical protein | A312L | NP\_048668.2 | n/d |  |
| OS5\_155L | 159128 | 159343 | 71 | hypothetical protein | A313L | NP\_048669.1 | CL0553 |  |
| OS5\_156R | 159423 | 159665 | 80 | hypothetical protein | A314R | NP\_048670.1 | CL0554 |  |
| OS5\_157R | 159689 | 161221 | 510 | hypothetical protein | A316R | NP\_048672.2 | n/d |  |
| OS5\_158R | 161279 | 161644 | 121 | hypothetical protein | A320R | NP\_048676.1 | CL0277 |  |
| OS5\_159R | 161681 | 162040 | 119 | hypothetical protein | A321R | NP\_048677.1 | CL0278 |  |
| OS5\_160L | 162151 | 162681 | 176 | hypothetical protein | A322L | NP\_048678.1 | CL0280 |  |
| OS5\_161L | 162733 | 164067 | 444 | hypothetical protein | A324L | NP\_048680.1 | CL0281 |  |
| OS5\_162L | 164148 | 164786 | 212 | hypothetical protein | A326L | NP\_048682.1 | CL0282 |  |
| OS5\_163L | 164817 | 165884 | 355 | hypothetical protein | A328L | NP\_048684.1 | n/d |  |
| OS5\_164R | 165974 | 166264 | 96 | hypothetical protein | A329R | NP\_048685.1 | CL0284 |  |
| OS5\_165R | 167717 | 168559 | 280 | hypothetical protein | A267L | NP\_048621.1 | CL0490 |  |
| OS5\_166R | 169037 | 169216 | 59 | hypothetical protein | a329cR | YP\_004678937.1 | n/d |  |
| OS5\_167L | 169229 | 170410 | 393 | hypothetical protein | A333L | NP\_048688.2 | n/d |  |
| OS5\_168L | 170451 | 171251 | 266 | hypothetical protein | A337L | NP\_048693.2 | CL0291 |  |
| OS5\_169L | 171389 | 171940 | 183 | hypothetical protein | A337L | NP\_048693.2 | n/d |  |
| OS5\_170L | 172002 | 172409 | 135 | hypothetical protein | A341L | NP\_048698.2 | CL0292 |  |
| OS5\_171L | 172496 | 173350 | 284 | GIY-YIG catalytic domain-containing endonuclease | A315L | NP\_048671.1 | n/d |  |
| OS5\_172L | 173430 | 175124 | 564 | hypothetical protein | A342L | NP\_048699.1 | CL0293 |  |
| OS5\_173L | 175222 | 175533 | 103 | hypothetical protein | A349L | NP\_048706.2 | CL0294 |  |
| OS5\_174R | 175644 | 176012 | 122 | hypothetical protein | A350R | NP\_048707.1 | CL0296 |  |
| OS5\_175L | 176126 | 176749 | 207 | hypothetical protein | A352L | NP\_048709.1 | CL0297 |  |
| OS5\_176L | 176813 | 177826 | 337 | hypothetical protein | A357L | NP\_048714.2 | n/d |  |
| OS5\_177R | 177896 | 181510 | 1204 | Superfamily II helicase | A363R | NP\_048717.2 | CN0016 |  |
| OS5\_178R | 181634 | 182059 | 141 | hypothetical protein | A373R | NP\_048730.1 | CL0301 |  |
| OS5\_179R | 182179 | 183123 | 314 | hypothetical protein | A007/008L | NP\_048352.1 | CN0006 |  |
| OS5\_180L | 183237 | 183962 | 241 | hypothetical protein | A378L | NP\_048735.2 | CN0001 |  |
| OS5\_181L | 183986 | 184615 | 209 | hypothetical protein | A379L | NP\_048736.1 | CL0304 |  |
| OS5\_182R | 184788 | 186248 | 486 | Major capsid protein (IV) | A383R | NP\_048739.2 | CN0004 |  |
| OS5\_183R | 186272 | 186457 | 61 | hypothetical protein | A384bL | YP\_004678944.1 | CL0307 |  |
| OS5\_184L | 186540 | 188390 | 616 | Chitin binding domain-containing protein, Capsid protein (V) | A384dL | NP\_048747.2 | n/d |  |
| OS5\_185R | 188481 | 189245 | 254 | DNA packaging ATPase | A392R | NP\_048749.2 | n/d |  |
| OS5\_186R | 189281 | 189490 | 69 | Hypothetical protein | NC64A\_NY2A\_B537R | YP\_001497733.1 | n/d |  |
| OS5\_187R | 189502 | 189906 | 134 | hypothetical protein | A394R | NP\_048751.1 | CL0310 |  |
| OS5\_188L | 189992 | 191476 | 494 | hypothetical protein, no hits with anything | NSSF |  | n/d |  |
| OS5\_189R | 191560 | 191811 | 83 | hypothetical protein | A395R | NP\_048752.1 | n/d |  |
| OS5\_190L | 191964 | 192422 | 152 | hypothetical protein | A396L | NP\_048753.2 | CL0312 |  |
| OS5\_191L | 192477 | 192833 | 118 | hypothetical protein | A398L | NP\_048755.1 | CL0314 |  |
| OS5\_192R | 192906 | 193490 | 194 | RNase H | A399R | NP\_048756.1 | CL0315 |  |
| OS5\_193R | 193523 | 193876 | 117 | hypothetical protein | A400R | NP\_048757.1 | n/d |  |
| OS5\_194R | 193914 | 194768 | 284 | hypothetical protein | A401R | NP\_048758.1 | CL0317 |  |
| OS5\_195R | 194788 | 195489 | 233 | Lipoprotein lipase? | A402R | NP\_048759.1 | CL0318 |  |
| OS5\_196R | 195608 | 195889 | 93 | hypothetical protein | A403R | NP\_048760.1 | CL0319 |  |
| OS5\_197R | 195920 | 196507 | 195 | hypothetical protein | A404R | NP\_048761.2 | CL0320 |  |
| OS5\_198L | 196498 | 196656 | 52 | hypothetical protein | A404aL | YP\_004678950.1 | n/d |  |
| OS5\_199R | 196715 | 198421 | 568 | hypothetical protein, Pro rich protein | A405R | NP\_048762.1 | CL0822 |  |
| OS5\_200L | 198424 | 199056 | 210 | hypothetical protein | A407L | NP\_048764.1 | CL0322 |  |
| OS5\_201L | 199094 | 199861 | 255 | hypothetical protein | A408L | NP\_048765.1 | n/d |  |
| OS5\_202L | 199867 | 200196 | 109 | hypothetical protein | A410L | NP\_048767.1 | n/d |  |
| OS5\_203R | 200284 | 200790 | 168 | hypothetical protein | A411R | NP\_048768.1 | n/d |  |
| OS5\_204R | 200799 | 201365 | 188 | hypothetical protein | A412R | NP\_048769.1 | CL0326 |  |
| OS5\_205L | 201366 | 202070 | 234 | hypothetical protein | A413L | NP\_048770.2 | CL0327 |  |
| OS5\_206R | 202149 | 202367 | 72 | hypothetical protein | A414R | NP\_048771.1 | CL0501 |  |
| OS5\_207R | 202443 | 203006 | 187 | Deoxynucleoside kinase | A416R | NP\_048773.1 | CL0427 |  |
| OS5\_208L | 202982 | 204271 | 429 | Replication factor C | A417L | NP\_048774.1 | CL0426 |  |
| OS5\_209L | 204303 | 204515 | 70 | hypothetical protein | A420L | NP\_048777.1 | CL0496 |  |
| OS5\_210R | 204560 | 204859 | 99 | hypothetical protein | A421R | NP\_048778.1 | CL0425 |  |
| OS5\_211R | 204883 | 205077 | 64 | hypothetical protein | A422aR | YP\_004678951.1 | CL0498 |  |
| OS5\_212R | 205088 | 205576 | 162 | hypothetical protein | A423R | NP\_048780.1 | CL0424 |  |
| OS5\_213R | 205604 | 205987 | 127 | hypothetical protein, no hits | NSSF |  | n/d |  |
| OS5\_214R | 206022 | 206366 | 114 | hypothetical protein | A426R | NP\_048783.1 | CL0423 |  |
| OS5\_215L | 206363 | 206704 | 113 | Thioredoxin | A427L | NP\_048784.1 | CN0033 |  |
| OS5\_216L | 206778 | 207182 | 134 | Choline-binding protein A | A428L | NP\_048785.1 | n/d |  |
| OS5\_217L | 207208 | 208569 | 453 | Ankyrin repeat-containing protein | A429L | NP\_048786.2 | CL0421 |  |
| OS5\_218R | 208720 | 209466 | 248 | GIY-YIG catalytic domain-containing endonuclease | A315L | NP\_048671.1 | n/d |  |
| OS5\_219L | 209523 | 210836 | 437 | Major capsid protein VP54 (I) | A430L (strong match) | NP\_048787.1 | CN0004 |  |
| OS5\_220L | 210916 | 211734 | 272 | GIY-YIG catalytic domain-containing endonuclease | A315L | NP\_048671.1 | n/d |  |
| OS5\_221R | 211852 | 212298 | 148 | hypothetical protein | A432R | NP\_048789.2 | CL0418 |  |
| OS5\_222L | 212295 | 212456 | 53 | PBCV-specific basic adaptor domain-containing protein | A436L | NP\_048793.2 | CL0349 |  |
| OS5\_223L | 212524 | 212850 | 108 | Chromosomal protein MC1 | A437L | NP\_048794.2 | CL0417 |  |
| OS5\_224L | 212879 | 213115 | 78 | Glutaredoxin | A438L | NP\_048795.1 | CN0032 | yes |
| OS5\_225R | 213138 | 213476 | 112 | hypothetical protein | A439R | NP\_048796.1 | n/d |  |
| OS5\_226R | 213483 | 213644 | 53 | hypothetical protein | A439aR | YP\_004678955.1 | n/d |  |
| OS5\_227L | 213633 | 214046 | 137 | hypothetical protein | A441L | NP\_048798.1 | CL0414 |  |
| OS5\_228R | 214187 | 215113 | 308 | hypothetical protein | A443R | NP\_048800.1 | CL0412 |  |
| OS5\_229L | 215128 | 215790 | 220 | SAM-dependent methyltransferase | NC64A\_CviKI\_481L | AGE51569.1 | CL0065 |  |
| OS5\_230L | 215845 | 216132 | 95 | hypothetical protein | A444L | NP\_048801.1 | CL0411 |  |
| OS5\_231L | 216225 | 217613 | 462 | 2-poly prenylphenol 6-hydrolase domain, protein kinase, glycosyltransferase [A445L?], ABC transporter | A445L | NP\_048802.2 | CL0410 |  |
| OS5\_232L | 217674 | 217994 | 106 | protein disulfide isomerase | A448L | NP\_048805.1 | CL0409 |  |
| OS5\_233R | 218144 | 218728 | 194 | mRNA capping enzyme beta chain, RNA triphosphatase | A449R | NP\_048806.1 | CL0407 | yes |
| OS5\_234R | 218962 | 219720 | 252 | hypothetical protein | A450R | NP\_048807.1 |  |  |
| OS5\_235L | 219757 | 220581 | 274 | Lysophospholipase, AB abhydrolase | A271L | NP\_048625.2 | CL0192 |  |
| OS5\_236L | 220697 | 221110 | 137 | hypothetical protein (possible intein) | A452L | NP\_048809.2 | CL0406 |  |
| OS5\_237L | 221278 | 222108 | 288 | hypothetical protein | A454L | NP\_048811.1 | CL0405 |  |
| OS5\_238L | 222175 | 224136 | 653 | Phage/plasmid primase, ATPase, superfamily III helicase | A456L | NP\_048813.1 | CN0026 |  |
| OS5\_239R | 224270 | 224455 | 61 | hypothetical protein | A461R | YP\_004678958.1 | CL0067 |  |
| OS5\_240R | 224489 | 225301 | 270 | RNase III | A464R | NP\_048820.1 | CL0402 | yes |
| OS5\_241R | 225339 | 225695 | 118 | Thiol oxidoreductase | A465R | NP\_048821.1 | CN0028 |  |
| OS5\_242L | 225720 | 226658 | 312 | hypothetical protein | A467L | NP\_048823.1 | CL0399 |  |
| OS5\_243R | 226807 | 228132 | 441 | DNA primase | A468R | NP\_048824.1 | CL0398 |  |
| OS5\_244R | 228196 | 228771 | 191 | hypothetical protein | A470R | NP\_048826.1 | CL0397 |  |
| OS5\_245R | 228823 | 229344 | 173 | hypothetical protein | A471R | NP\_048827.1 | CL0396 |  |
| OS5\_246R | 229482 | 230456 | 324 | Ribonucleoside-diphosphate reductase small subunit | A476R | NP\_048832.1 | n/d |  |
| OS5\_247L | 230437 | 231321 | 294 | hypothetical protein | A490L | NP\_048846.1 | n/d |  |
| OS5\_248L | 231357 | 231632 | 91 | hypothetical protein | A480L | NP\_048836.1 | CL0394 |  |
| OS5\_249L | 231660 | 232343 | 227 | Ring finger ubiquitin ligase | A481L | NP\_048837.1 | CL0271 |  |
| OS5\_250R | 232422 | 233066 | 214 | MYM-type zinc finger with FCS sequencing motif, VLTF2 type transcription factor | A482R | NP\_048838.1 | CL0393 |  |
| OS5\_251L | 233061 | 233528 | 155 | hypothetical protein | A484L | NP\_048840.1 | CL0392 |  |
| OS5\_252R | 233611 | 234054 | 147 | hypothetical protein | A485R | NP\_048841.1 | n/d |  |
| OS5\_253R | 234068 | 234334 | 88 | hypothetical protein | Pbi\_Can18-4\_476L | AGE49834.1 | CL0494 |  |
| OS5\_254R | 234378 | 235337 | 319 | hypothetical protein | A488R | NP\_048844.1 | CL0390 |  |
| OS5\_255R | 235387 | 235617 | 76 | hypothetical protein | A491R | NP\_048847.1 | CL0389 |  |
| OS5\_256L | 235614 | 236159 | 181 | hypothetical protein | A492L | NP\_048848.1 | n/d |  |
| OS5\_257R | 236201 | 237295 | 364 | Pox VLTF3 late transcription factor | A494R | NP\_048850.1 | CL0386 |  |
| OS5\_258R | 237349 | 237789 | 146 | hypothetical protein | A497R | NP\_048853.1 | CL0385 |  |
| OS5\_259L | 237839 | 238891 | 350 | hypothetical protein, lot of PAPKs | A500L | NP\_048856.2 | CL0383 |  |
| OS5\_260L | 238925 | 239212 | 95 | hypothetical protein | A502L | NP\_048858.1 | CL0381 |  |
| OS5\_261L | 239258 | 240097 | 279 | hypothetical protein | A503L | NP\_048859.1 | CL0380 |  |
| OS5\_262L | 240176 | 241675 | 499 | hypothetical protein | A505L | NP\_048861.1 | CL0379 |  |
| OS5\_263R | 241859 | 242422 | 187 | hypothetical protein | Pbi\_MT325\_m295L | ABT13849.1 | CL0485 |  |
| OS5\_264L | 242444 | 242692 | 82 | hypothetical protein | A519L | NP\_048875.1 | CL0377 |  |
| OS5\_265L | 242697 | 242996 | 99 | hypothetical protein | A520L | NP\_048876.2 | CL0376 |  |
| OS5\_266L | 243014 | 243562 | 182 | Zn metallopeptidase | A521L | NP\_048877.2 | CL0374 |  |
| OS5\_267L | 243591 | 244208 | 205 | Putative metallopeptidase WLM | A521aL | YP\_004678965.1 | n/d |  |
| OS5\_268R | 244263 | 244796 | 177 | hypothetical protein | A523R | NP\_048879.1 | CL0372 |  |
| OS5\_269R | 244839 | 245279 | 146 | hypothetical protein | A526R | NP\_048882.2 | CL0371 |  |
| OS5\_270R | 245257 | 245571 | 104 | hypothetical protein | A527R | NP\_048883.2 | CL0370 |  |
| OS5\_271R | 245686 | 245958 | 90 | Hypothetical protein | a528R | NP\_048884.1 | n/d |  |
| OS5\_272R | 245922 | 246974 | 350 | DNA cytosine-specific methyltransferase | A530R | NP\_048886.2 | n/d | yes |
| OS5\_273L | 246971 | 247165 | 64 | hypothetical protein | A531L | NP\_048887.1 | CL0777 |  |
| OS5\_274L | 247197 | 247436 | 79 | hypothetical protein | A532L | NP\_048888.1 | CL0369 |  |
| OS5\_275L | 247463 | 247615 | 50 | hypothetical protein | A532aL | YP\_004678967.1 | n/d |  |
| OS5\_276R | 247715 | 249310 | 531 | hypothetical protein | A533R | NP\_048889.1 | CL0368 |  |
| OS5\_277L | 249312 | 249536 | 74 | hypothetical protein | A535L | NP\_048891.1 | CL0367 |  |
| OS5\_278L | 249602 | 249856 | 84 | hypothetical protein | A536L | NP\_048892.1 | CL0366 |  |
| OS5\_279L | 249861 | 250676 | 271 | hypothetical protein | A537L | NP\_048893.1 | CL0364 |  |
| OS5\_280R | 250760 | 251305 | 181 | GIY-YIG catalytic domain-containing endonuclease | A539R | NP\_048895.1 | CL0363 |  |
| OS5\_281L | 251321 | 254722 | 1133 | Chlorovirus glycoprotein repeat domain-containing, virus tail fiber | A540L | NP\_048896.2 | CN0011 |  |
| OS5\_282R | 254843 | 255739 | 298 | ATP-dependent DNA ligase | A544R | NP\_048900.1 | CL0362 |  |
| OS5\_283L | 255721 | 256950 | 409 | glycosyl transferase | A546L | NP\_048902.4 | CL0279 |  |
| OS5\_284L | 256937 | 258307 | 456 | ATP-dependent SNF2 helicase | A548L | NP\_048904.2 | CL0361 |  |
| OS5\_285L | 258399 | 258836 | 145 | dUTP diphosphatase | A551L | NP\_048907.1 | CL0360 | yes |
| OS5\_286R | 258963 | 259916 | 317 | transcription factor TFIID | A552R | NP\_048908.3 | CL0359 |  |
| OS5\_287L | 259931 | 261427 | 498 | tRNA(Ile)-lysidine synthase | A554/556/557L | NP\_048910.2 | CL0357 |  |
| OS5\_288L | 261527 | 262729 | 400 | Capsid protein (III) | A558L | NP\_048914.1 | CN0004 |  |
| OS5\_289L | 262842 | 263513 | 223 | hypothetical protein | A559L | NP\_048915.1 | CL0354 |  |
| OS5\_290L | 263551 | 265575 | 674 | DNA binding protein, lysine activity | A561L | NP\_048917.1 | CN0001 |  |
| OS5\_291R | 265665 | 266477 | 270 | GIY-YIG catalytic containing endonuclease | A287R | NP\_048641.2 | n/d |  |
| OS5\_292R | 266499 | 268562 | 687 | hypothetical protein | A565R | NP\_048921.2 | CN0001 |  |
| OS5\_293L | 268575 | 269000 | 141 | hypothetical protein | A567L | NP\_048923.1 | n/d |  |
| OS5\_294L | 269023 | 269577 | 184 | hypothetical protein | A568L | NP\_048924.1 | CL0350 |  |
| OS5\_295L | 269601 | 269813 | 70 | hypothetical protein | A570L | NP\_048926.1 | n/d |  |
| OS5\_296R | 270059 | 270409 | 116 | PBCV-specific basic adaptor domain-containing protein | A571R | NP\_048927.1 | n/d |  |
| OS5\_297R | 270423 | 270968 | 181 | hypothetical protein | A572R | NP\_048928.1 | CL0348 |  |
| OS5\_298L | 270974 | 271720 | 248 | PCNA | A574L | NP\_048930.1 | CN0019 |  |
| OS5\_299L | 271795 | 272301 | 168 | hypothetical protein | A575L | NP\_048931.1 | CN0020 |  |
| OS5\_300L | 272408 | 272815 | 135 | hypothetical protein | A577L | NP\_048933.2 | n/d |  |
| OS5\_301L | 272831 | 276016 | 1061 | DNA topoisomerase II | A583L | NP\_048939.2 | CL0343 | yes |
| OS5\_302L | 276146 | 277255 | 369 | hypothetical protein | A590L | NP\_048946.2 | CL0917 |  |
| OS5\_303R | 277480 | 278118 | 212 | hypothetical protein | NC64A\_KS1B\_271R | AGE54561.1 | CL0500 |  |
| OS5\_304R | 278391 | 279254 | 287 | hypothetical protein | A593R | NP\_048949.2 | CL0341 |  |
| OS5\_305R | 279287 | 279715 | 142 | dCMP deaminase | A596R | NP\_048952.1 | CL0340 | yes |
| OS5\_306R | 279802 | 280368 | 188 | hypothetical protein | NC64A\_NY2A\_B871R | YP\_001498067.1 | CL0455 |  |
| OS5\_307L | 280363 | 281517 | 384 | Histidine decarboxylase | A598L | NP\_048954.1 | CL0339 |  |
| OS5\_308R | 281594 | 282511 | 305 | ADP-ribosylglycohydrolase | NSSF |  | n/d |  |
| OS5\_309R | 282565 | 282864 | 99 | hypothetical protein | A601R | NP\_048957.1 | CL0338 |  |
| OS5\_310L | 282854 | 283105 | 83 | Ubiquitin, It is probably 3 amino acids too long | NSSF |  | n/d |  |
| OS5\_311L | 283120 | 283542 | 140 | hypothetical protein | A602L | NP\_048958.2 | CL0337 |  |
| OS5\_312R | 283647 | 283961 | 104 | hypothetical protein | a603R | NP\_048959.1 | CL0336 |  |
| OS5\_313R | 284002 | 284145 | 47 | hypothetical protein | a603bR | YP\_004678984.1 | CL0069 |  |
| OS5\_314L | 284149 | 284640 | 163 | Zn metallopeptidase? | A604L | NP\_048960.1 | CL0335 |  |
| OS5\_315L | 284651 | 285127 | 158 | hypothetical protein | A605L | NP\_048961.1 | CL0333 |  |
| OS5\_316R | 285187 | 286548 | 453 | Cell envelope protein – Rhizobium | Pbi\_NE-JV-1\_839L | AGE56446.1 | CL0034 |  |
| OS5\_317R | 286578 | 287750 | 390 | Ankyrin repeat-containing protein | A607R | NP\_048963.2 | n/d |  |
| OS5\_318L | 287759 | 288928 | 389 | UDP-glucose dehydrogenase | A609L | NP\_048965.1 | CL0287 | yes |
| OS5\_319L | 289010 | 289369 | 119 | Histone H3K27 methylase | A612L | NP\_048968.1 | CL0331 | yes |
| OS5\_320L | 289423 | 291135 | 570 | Ser/Thr-protein kinase? | A614L | NP\_048970.2 | CN0002 | yes |
| OS5\_321R | 291206 | 292177 | 323 | Ser/Thr protein kinase | A617R | NP\_048973.2 | n/d | yes |
| OS5\_322L | 292192 | 292602 | 136 | hypothetical protein | A618L | NP\_048974.1 | CL0328 |  |
| OS5\_323L | 292619 | 293305 | 228 | Transposase | A619L | NP\_048975.1 | CL0382 |  |
| OS5\_324L | 293345 | 293596 | 83 | hypothetical protein | A620L | NP\_048976.1 | n/d |  |
| OS5\_325L | 293616 | 293972 | 118 | hypothetical protein | A621L | NP\_048977.2 | CL0432 |  |
| OS5\_326L | 294030 | 295607 | 525 | capsid protein (II) | A622L | NP\_048978.1 | CN0004 |  |
| OS5\_327R | 295894 | 296262 | 122 | Putative membrane protein | A624R | NP\_048980.1 | CL0428 |  |
| OS5\_328R | 296281 | 297597 | 438 | hypothetical protein | A627R | NP\_048983.1 | CN0012 |  |
| OS5\_329L | 297616 | 297939 | 107 | hypothetical protein | A628L | NP\_048984.1 | n/d |  |
| OS5\_330R | 298102 | 300405 | 767 | Ribonucleotide reductase large subunit | A629R | NP\_048985.1 | CL0434 |  |
| OS5\_331R | 300485 | 300808 | 107 | hypothetical protein | A633R | NP\_048989.1 | CL0435 |  |
| OS5\_332L | 300809 | 301228 | 139 | hypothetical protein | A634L | NP\_048990.1 | CL0436 |  |
| OS5\_333R | 301294 | 302916 | 540 | CTP synthetase | NSSF |  | n/d |  |
| OS5\_334R | 303079 | 303342 | 87 | hypothetical protein | A635R | NP\_048991.1 | n/d |  |
| OS5\_335R | 303412 | 303837 | 141 | hypothetical protein | A637R | NP\_048993.1 | CL0439 |  |
| OS5\_336R | 303931 | 305247 | 438 | hypothetical protein | A643R | NP\_048999.2 | CL0442 |  |
| OS5\_337R | 305286 | 305801 | 171 | hypothetical protein | A644R | NP\_049000.2 | CL0443 |  |
| OS5\_338R | 305895 | 306272 | 125 | hypothetical protein | A645R | NP\_049001.1 | n/d |  |
| OS5\_339R | 306560 | 307333 | 257 | protein of unknown function (DUF1390) | A649R | NP\_049005.1 | n/d |  |
| OS5\_340L | 307340 | 307792 | 150 | Polyamine acetytransferase | A654L | NP\_049010.1 | CL0445 | yes |
| OS5\_341L | 308001 | 308648 | 215 | hypothetical protein | A656L | NP\_049012.2 | n/d |  |
| OS5\_342L | 308835 | 309407 | 190 | hypothetical protein | A659L | NP\_049015.2 | n/d |  |
| OS5\_343L | 309431 | 309946 | 171 | Mpv17/PMP22 family protein, mito & peroxisome membrane | A662L | NP\_049018.1 | CL0447 |  |
| OS5\_344L | 310032 | 310493 | 153 | hypothetical protein | A664L | NP\_049020.2 | CL0449 |  |
| OS5\_345L | 310634 | 311140 | 168 | hypothetical protein | A348R | NP\_048705.1 | CL0556 |  |
| OS5\_346L | 311347 | 311814 | 155 | hypothetical protein | A665L | NP\_049021.2 | CL0449 |  |
| OS5\_347L | 311849 | 314461 | 870 | Calcium-transporting ATPase | NC64A\_KS1B\_652L | AGE54749.1 | CL0504 | yes |
| OS5\_348R | 314621 | 315064 | 147 | hypothetical protein | NSSF |  | n/d |  |
| OS5\_349L | 315072 | 315335 | 87 | hypothetical protein | NC64A\_KS1B\_658L | AGE54750.1 | CL0953 |  |
| OS5\_350L | 315381 | 318224 | 947 | Translation elongation factor 3 | A666L | NP\_049022.1 | CL0450 |  |
| OS5\_351R | 318294 | 318917 | 207 | Ankyrin repeat PH and SEC7 domain containing protein | A672R | NP\_049028.1 | n/d |  |
| OS5\_352R | 319153 | 319803 | 216 | Thymidylate synthase X | A674R | NP\_049030.1 | CL0453 | yes |
| OS5\_353R | 319842 | 320954 | 370 | PBCV-specific basic adaptor domain-containing protein | A676R | NP\_049032.2 | CN0002 |  |
| OS5\_354R | 321051 | 323288 | 745 | Ser/Thr protein phosphatase 6 regulatory ankyrin repeat subunit B like | A330R | NP\_048686.1 | n/d |  |
| OS5\_355R | 323337 | 324515 | 392 | Alpha-L-arabinofuranosidase | SAG3.83\_ATCV1\_Z832L | YP\_001427313.1 | CL0539 |  |
| OS5\_356R | 325064 | 325249 | 61 | hypothetical protein | a004L | NP\_048352.1 | CL0757 |  |
| OS5\_357R | 326103 | 326669 | 188 | hypothetical protein | SAG3.83\_TN603.4.2\_002L | AGE59612.1 | CL0468 |  |

NSSF = no significant sequence found in BLASTp search

n/d = none determined

#Recombinant proteins have been produced from Chlorovirus PBCV-1 homologs of these CDSs and shown to have the expected activity.

**Sup. Table. 2. OSy-NE5 encoded tRNAs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| tRNA | Anticodon | tRNA#a | Begin | End |
| Leu | TAA | 1 | 166543 | 166625 |
| Leu | TAA | 2 | 166734 | 166816 |
| Leu | TAA | 3 | 166925 | 167007 |
| Asn | GTT | 4 | 167117 | 167190 |
| Gly | TCC | 5 | 167194 | 167264 |
| Asn | GTT | 6 | 167288 | 167361 |
| Lys | CTT | 7 | 167365 | 167437 |
| Arg | TCT | 8 | 167465 | 167536 |
| Arg | TCT | 9 | 167564 | 167635 |
| Tyrb | GTA | 10 | 168635 | 168719 |
| Asp | GTC | 11 | 168747 | 168818 |
| Leu | CAA | 12 | 168820 | 168900 |
| Thr | TGT | 13 | 168904 | 168975 |

a Order of the tRNA in the OSy-NE5 genome.

b tRNA contains a predicted intron.

**Sup. Table. 3. Genes used in the color-coded map in Figure 6.**

**CDS no. Size annotation**

**A). DNA replication, recombination and repair**

OS5\_115L 913 DNA polymerase –681+232 aa

OS5\_243R 441 DNA primase

OS5\_282R 298 ATP-dependent DNA ligase

OS5\_208L 429 Replication factor C

OS5\_113R 262 PCNA-sliding clamp

OS5\_298L 248 PCNA-sliding clamp

OS5\_301L 1061 DNA topoisomerase II

OS5\_192R 194 RNase H

OS5\_185R 254 ATPase (DNA packaging)

OS5\_012L 141 Pyrimidine dimer-specific glycosylase

OS5\_009L 611 AAA ATPase

OS5\_238L 653 Phage/plasmid primase

OS5\_019R 247 Methyltransferase FkbM family

OS5\_005L 568 DNA binding protein

OS5\_290L 674 DNA binding protein

**B). Transcription**

OS5\_040R 330 mRNA-capping enzyme guanylyltransferase

OS5\_233R 194 RNA triphosphatase

OS5\_042L 290 transcription factor TFIIB

OS5\_286R 317 transcription factor TFIID

OS5\_048L 180 transcription factor TFIIS

OS5\_250R 214 VLTF2-type transcription factor

OS5\_257R 364 Pox\_VLTF3 superfamily transcription factor

OS5\_284L 456 ATP-dependent SNF 2 helicase

OS5\_060R 464 ATP dependent RNA helicase

OS5\_088L 725 DEAE/DEAH box II RNA helicase

OS5\_177R 1204 Superfamily II helicase

OS5\_114L 1376 SWI/SNF chromatin remodeling complex

OS5\_110L 118 Cytidine and deoxycytidylate deaminase

OS5\_240R 270 RNase III

OS5\_319L 119 Histone H3K27 methylase

OS5\_287L 498 tRNA (ile)-lysine synthase

**C). Protein synthesis, modification and degradation**

OS5\_007L 148 SKP1-like protein

OS5\_033R 226 prolyl 4-hydroxylase

OS5\_041L 272 ubiquitin carboxyl-terminal hydrolase

OS5\_232L 106 Protein disulfide isomerase

OS5\_310L 81 ubiquitin - present in 4 other CVs

OS5\_350L 947 Translation elongation factor 3

OS5\_241R 118 Thiol oxidoreductase

OS5\_249L 227 Ring finger ubiquitin ligase

OS5\_266L 182 Zn metallopeptidase

OS5\_314L 163 Zn metallopeptidase

**D). DNA modification**

OS5\_126R 377 Adenine-specific methyltransferase

OS5\_128R 371 Adenine-specific methyltransferase

OS5\_129R 392 Adenine-specific methyltransferase

OS5\_272R 350 cytosine-specific methyltransferase

**E). Integration and transposition**

OS5\_043L 161 GIY-YIG catalytic domain-containing endonuclease

OS5\_053L 164 GIY-YIG catalytic domain-containing endonuclease

OS5\_061L 270 GIY-YIG catalytic domain-containing endonuclease

OS5\_100L 266 GIY-YIG catalytic domain-containing endonuclease

OS5\_121L 251 GIY-YIG catalytic domain-containing endonuclease

OS5\_171L 284 GIY-YIG catalytic domain-containing endonuclease

OS5\_218R 248 GIY-YIG catalytic domain-containing endonuclease

OS5\_220L 272 GIY-YIG catalytic domain-containing endonuclease

OS5\_280R 202 GIY-YIG catalytic domain-containing endonuclease

OS5\_291R 270 GIY-YIG catalytic domain-containing endonuclease

OS5\_046R 104 Tir 6Fp DNA mobile protein

OS5\_323L 228 transposase

**F). Lipid manipulation**

OS5\_235L 264 Lysophospholipase

OS5\_074L 275 Patatin-like phospholipase

OS5\_011L 209 glycerophosphoryl diestrase phosphodiesterase

OS5\_144L 174 phosphoglycerate mutase

OS5\_195R 227 Lipoprotein lipase

**G). Nucleotide metabolism**

OS5\_072R 323 Aspartate transcarbamylase

OS5\_207R 187 Deoxynucleoside kinase

OS5\_215L 113 thioredoxin

OS5\_224L 78 Glutaredoxin

OS5\_246R 324 ribonucleoside reductase small subunit

OS5\_330R 767 Ribonucleotide reductase large subunit

OS5\_285L 141 dUTP pyrophosphatase

OS5\_305R 142 dCMP deaminase

OS5\_333R 540 CTP synthetase

OS5\_352R 216 Thymidylate synthase X

**H). Sugar metabolism and manipulation**

OS5\_038R 563 hyaluronan synthase

OS5\_039R 595 Glucosamine synthetase

OS5\_318L 389 UDP-glucose dehydrogenase

OS5\_045R 346 GDP-D-mannose dehydratase

OS5\_139L 312 GDP-L-fucose synthase 2

OS5\_017L 333 Glycosyltransferase domain

OS5\_044R 860 Glycosyltransferase

OS5\_097L 631 Cellulose synthase catalytic subunit

OS5\_283L 395 glycosyl transferase A546L homolog

OS5\_025L 279 exostosin

OS5\_015R 362 D-lactate dehydrogenase

**I). Cell wall degradation**

OS5\_037L 366 beta 1,3 glucanase

OS5\_117L 525 Bifunctional chitinase/lysozyme

OS5\_119R 505 Chitinase

OS5\_138L 337 Chitosanase

OS5\_099R 311 Alginate lyase

OS5\_290L 674 Lysin

**J). Signaling**

OS5\_004R 308 Ser/Thr protein kinase

OS5\_014L 269 aquaglyceroporin

OS5\_066R 448 Ligand-gated ion channel

OS5\_079L 94 Potassium ion channel protein

OS5\_149L 204 Dual specific phosphatase

OS5\_080L 288 Calcium/calmodulin dependent protein kinase

OS5\_133L 279 Ser/Thr protein kinase

OS5\_134L 614 Ser/Thr protein kinase

OS5\_137L 284 Ser /Thr protein kinase

OS5\_179R 314 Ser/Thr protein phosphatase 6 Has 5 ank repeats

OS5\_231L 462 Protein kinase domain

OS5\_320L 570 Ser/Thr protein kinase

OS5\_321R 323 Ser/Thr protein kinase

**K). Miscellaneous**

OS5\_029R 298 N-carbamoylputrescine amidohydrolase

OS5\_340L 197 Polyamine acetyltransferase

OS5\_090L 516 Homospermidine synthase

OS5\_105L 372 Arginine/ornithine decarboxylase

OS5\_098R 384 Amino oxidase

OS5\_120R 182 Chloramphenicol acetyltransferase

OS5\_135L 279 amidase

OS5\_307L 365 histidine decarboxylase

OS5\_142L 316 Fibronectin binding protein

**L). Structural proteins**

OS5\_086R 411 Major capsid protein

OS5\_182R 486 Major capsid protein

OS5\_219L 437 Major capsid protein Vp54

OS5\_288L 400 Major capsid protein

OS5\_326L 525 Major capsid protein

**Sup. Table. 4.** Proton and carbon chemical shifts (600 MHz) recorded in deuterated water at 310 K with acetone as internal standard. **F** is substituted at position *O*-3 with a methyl group (chemical shift 1H/13C: 3.64/61.6 ppm).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|   |   | **1** | **2** | **3** | **4** | **5 (5eq- 5ax)** | **6-6'** |
| **A** | 1H | 5.63 | 4.15 | 4.20 | 3.83 | 4.712 | 1.30 |
| **2,3,4- α-L-Fuc** | 13C | 98.5 | 71.9 | 77.0 | 82.4 | 68.5 | 16.18 |
| **B** | 1H | 5.22 | 3.81 | 3.84 | 4.02 | 4.02 | 3.73-3.70 |
| **α-D-Gal** | 13C | 100.2 | 69.5 | 70.9 | 70.3 | 72.5 | 62.3 |
| **C** | 1H | 5.02 | 4.03 | 4.09 | 3.74 | 3.49 | 1.28 |
| **α-L-Rha**  | 13C | 104.0 | 71.5 | 71.5 | 73.2 | 70.0 | 17.9 |
| **D** | 1H | 4.99 | 3.57 | 3.95 | 3.71 | 3.65 | 3.94-3.82 |
| **3,4-α-D-Glc** | 13C | 80.7 | 75.1 | 76.8 | 74.8 | 78.1 | 60.6 |
| **E** | 1H | 4.46 | 3.38 | 3.44 | 3.66 | 4.03-3.24 | - |
| **β-D-Xyl** | 13C | 105.5 | 74.7 | 76.9 | 70.6 | 66.0 | - |
| **F** | 1H | 4.43 | 3.18 | 3.234 | 3.66 | 4.00-3.23 | - |
| **β-D-Xyl 3OMe** | 13C | 103.9 | 74.6 | 86.8 | 70.6 | 66.0 | - |

**Sup. Fig. 1.** Expansion of OSy-NE5 glycopeptide HSQC spectrum measured at 600 MHz, 310 K. Carbons bearing two hydrogen atoms have densities of opposite sign compared to the others and are colored in grey.

****

**Sup. Fig. 2.** Expansion of OSy-NE5 glycopeptide T-ROESY spectrum measured at 600 MHz, 310 K.

