

| | | |
|----|--|-------------|
| 1 | MESSAVV- PGTTAPPLLPYAYAPLPSSADDAR-- ENQSSG | faSST |
| 1 | M----- ESRDI ESS- PALNAPL----- L QTTT | asSST |
| 1 | M----- ESRDI ESS- PALNAPL----- L QASP | acSST |
| 1 | MDSSRVILI PGTPLL- PYAYEQLPSSSADAKGI E EERAGG | taSST |
| 1 | MESSAVVVQGTTAPLLPYAYAPLPSSADDAR-- ENQSSG | lpSST |
| 1 | MMASSTTTTP----- L I L HDDPENLPELTGSP | htSST |
| 1 | M- - ASSTTTP----- LLPHHQLNPQQLAGSP | csSST |
| 1 | MASSTTATTP----- LI L RDETQI CPQLAGSP | ciSST |
| 1 | MASSTTAATP----- L I L HND----- ST | toSST |
| 1 | M- - SSSDLESP- PSSYLPPIP----- PSDEFHDQP | acINV |
| 1 | MMAS- - LSDVENSITTSTLPYSYAPLPNGEQ---- PAGN | cilNV |
| 1 | MDT- - YHFLPSRDLEHAS- YTTPRP- DSPETRHEPDPR | dcINV |
| 1 | MASS- DALLPI SAREEEPLCPYTRLPMADPNQ---- ETH | atINV |
| 1 | M- - SESSDSTLPYSYAPLATKNEFNGFGPGE | bvINV |
| 1 | MAATTSSAAKPYDLENAAAR- YAPLP- AGPHS---- CEI | ibINV |
| 1 | MATQC- - YDPENSASR- YTLLP- DQPDS----- | leINV |
| 1 | MEL- | lpINV |
| 1 | MA- - TSRLTPAYDLKNAAAAYTLP- EQPHS---- AEV | osINV |
| 1 | MATQYHS- - SYDPENSASH- YTFLP- DQPDS----- | stINV |
| 1 | ----- MI PAVADPTTL DGG- GARRPLLP----- ETDPGRGAAAGA | taINV(part) |
| 1 | ----- zmINV | |
| 37 | G- VRWRVCAAVLAASALAVLI VVGLLAG----- | faSST |
| 22 | PVKSSKLKVVLAI STSVILV LATFFA----- | asSST |
| 22 | PI KSSKLKVALLATSTSVLLLIAAFFA----- | acSST |
| 40 | GGLRWRACAALVLAASAVVALVVAAAVFG----- | taSST |
| 38 | GGVWRWRACA- - ASALVVL L VVVGFFAG----- | lpSST |
| 28 | TTRRLSI AKVLSGI LVSVLV GALVA- - LI NNQT---- YE | htSST |
| 26 | AAHRLSRPTL SGI LVSVLV CALVA- - VI HNQSQQPYH | csSST |
| 28 | VGRRLSMANVLSGI LVFVLV CVLVA- - VI HDQSQQI MAT | ciSST |
| 19 | PRRRLSLAKLLSGI PVAVLVI FALVT- - VI LNQSQHTSAT | toSST |
| 27 | PPLRSWLRLLSI PLALMFLLFLATFLSNLESPPSDSGLVS | acINV |
| 34 | DRPVHSSRKT- - ALFLVSVFLAVASL- - VALFAGNGPVL P | cilNV |
| 36 | SKTNRRPICKIVSSVLLSTLILSFVIF- - LLVNPNVQQVVR | dcINV |
| 35 | GPRRRRPFKG- - LLAVSFQLLFIAFY- - VALIATHDGSRS | atINV |
| 30 | NQPRRRRSLKI- - GLAVFSTLMI CALL- - MSI LDYNNNNVD | bvINV |
| 34 | PASHRPSLKSITILLLSSLFLCSLII- - LLVFNQSSSI EP | lpINV |
| 25 | -- GHRKSLKIIISGI FLSSFLLSVAF- - FPI L NNQSP- - | leINV |
| 4 | -- FMKNSSLWGLKFYLFCFLIVLLNI NRVFA SHNI FLD | osINV |
| 33 | EIRDRKPKFKII SAIILSSLLLALI L- - VAVNYQAPP- - | stINV |
| 28 | -- GHRKSLKIIISGI FLSSFLLSVAF- - FPI L NNQSP- - | taINV(part) |
| 1 | -- -- G----- LVA | zmINV |
| 35 | EQKRPPATPTVLTAVVSAVLLLV----- | |
| 64 | ----- GRVDRGPAGGDVASAA----- VPAVPM | faSST |
| 49 | -- VKYSV----- FESG | asSST |
| 49 | -- VKYSV----- FDSG | acSST |
| 68 | - A----- SGAGWDAVAAS----- VPATPA | taSST |
| 63 | ----- GRVDLGQDGEVSATSS----- VPG- - | lpSST |
| 62 | ----- SPSATTFTVQLPNI DL | htSST |
| 63 | ----- DGGA----- KPSSAAATTFTPTASPEAGL | csSST |
| 66 | NNH- QGGD----- KPTS----- AATFTAPLLQVDL | ciSST |
| 57 | GNI DFHGGD----- KPSS----- DTTFTE- MVPEEL | toSST |
| 67 | DPVTFDVNPAVRRGKDAGVSDKTSGVDSGFVLDPVAVDA | acINV |
| 70 | KNLNTSAVPSTAGM----- PEKMAPL----- | cilNV |
| 74 | K- KVSKNSNGED----- RNKASKSPEMLGPP----- | dcINV |
| 71 | NDEGI DETETI TTSRARLA----- GVSEKRNDGL | atINV |
| 66 | NNVSKNNAPNKYNVGDLTF- RPQOPENMASVEVMPGSKDLL | bvINV |
| 72 | DGPVVFAGSGNR----- SAESVNPGVVL PAP----- | ibINV |
| 58 | -- DL----- QI DSRSPA----- PP----- | lpINV |
| 40 | -- -- -- L QSSSAI SV | osINV |
| 68 | -- SHS----- SGDNSQPAAVMP- P----- | stINV |
| 61 | -- DL----- QSNSRSPA----- PP----- | taINV(part) |
| 2 | -- TR----- | zmINV |
| 61 | VTM LASOH----- MDGQAGGPAG- - EDAVVM | |

| | | | |
|----------------|---|-------------------------------------|-------------|
| 86 | - E I P R S R G K D F G V S E K A S G - | - A Y S A D G G F P W S N | faSST |
| 58 | - - - - - T G L V K E D A P A A G D G Y P W T N | - | asSST |
| 58 | - - - - - S G L L K D D P P S D S E D Y P W T N | - | acSST |
| 86 | TE F P R S R G K E H G V S E K T S G - | - A Y S A N A - F P W S N | taSST |
| 82 | - - - S S R G K D S G V S E K E S - | - P A D G G F P W S N | lpSST |
| 78 | K R V - P G K L D - | - | ss |
| 87 | K R F - P I E L K - | - | tn |
| 90 | K R V - P G K L E - | - | sn |
| 82 | K Q V - L I K L E - | - | sn |
| 107 | N S V V V H R G K D A G V S D K T S G V D S G L L K D S P L G P - | - Y P W T N | acINV |
| 91 | - - - S R G V E K G V S E K S - | - F H - P L L G A D N S F - P W S N | ciINV |
| 99 | - - - S R G V S Q G V S E K S - | - F R Q A T A E P - S Y P W T N | dcINV |
| 99 | W K L - S G D R - | - - - N T P A F E W N N | atINV |
| 105 | F K V - S R G K P H G V S Q K A - | - N S L P L R G L K V P F F D W N D | bvINV |
| 98 | - - - S R G V S Q G V S E K A - | - F R G V S G G R - I S Y P W S N | ibINV |
| 70 | - - - S R G V S Q G V S D K T - | - F R D V A G A S H - V S Y A W S N | leINV |
| 49 | K N V - | - | lpINV |
| 84 | - - - S R G V S Q G V S E K A - | - F R G A S G A G N G V S F A W S N | osINV |
| 73 | - - - S R G V S Q G V S D K T - | - F R D V V N A S H - V S Y A W S N | stINV |
| 4 | - - - - - | - | taINV(part) |
| 87 | - V A A S R G V A E G V S E K S T A P - | LL - G S G A L Q D F S W T N | zmINV |
| suc-box | | | |
| 116 | A M L Q W Q R T G F H F Q P E K H Y M N D P N G P V Y Y G G W Y H L F Y Q Y N P | - | faSST |
| 77 | D M F E W Q Q R P G Y H F Q P P Y H F M G D P N A A M Y Y K G W Y H F F Y Q Y N P | - | asSST |
| 77 | E M L K W Q R T G Y H F Q P P N H F M A D P N A A M Y Y K G W Y H F F Y Q Y N P | - | acSST |
| 116 | A M L Q W Q R T G Y H F Q P D K Y Y Q N D P N G P V Y Y G G W Y H F F Y Q Y N P | - | taSST |
| 106 | A M L Q W Q H T G F H F Q P L K H Y M N D P N G P V Y Y G G W Y H L F Y Q H N P | - | lpSST |
| 88 | A E V E W Q R S T Y H F Q P D K N F I S D P D G P M Y H M G W Y H L F Y Q Y N P | - | htSST |
| 97 | A E V E W Q R S A Y H F Q P D K N F I S D P D G P M Y H M G W Y H L F Y Q Y N P | - | csSST |
| 100 | A D V E W Q R S A Y H F Q P D K N F I S D P D G P M Y H M G W Y H L F Y Q Y N P | - | ciSST |
| 92 | A G V E W E R S A Y H F Q P D K N F I S D P D G P M Y H M G W Y H L F Y Q Y N P | - | toSST |
| 144 | Q M L S W Q R T G F H F Q P V K N W M N D P N G P L Y Y K G W Y H F F Y Q Y N P | - | acINV |
| 118 | N M L D W Q R T A F H F Q P K K N W M N D P N G P L V F Y N G W Y H L F Y Q Y H P | - | ciINV |
| 125 | D M L S W Q R T S F H F Q P Q E N W M N D P N G P L F H M G W Y H L F Y Q Y N P | - | dcINV |
| 115 | S M L S W Q R T A F H F Q P E Q N W M N D P N G P L F Y K G W Y H F F Y Q Y N P | - | atINV |
| 137 | L Q L A W Q R T A F H F Q P Q K N W M N D P N G P L Y Y N G W Y H F F Y Q Y N P | - | bvINV |
| 125 | L M L T W Q R T A Y H F Q P E K N W M N D P N G P L Y Y K G W Y H F F Y Q Y N P | - | ibINV |
| 98 | A M L S W Q R T A Y H F Q P Q K N W M N D P N G P L Y H K G W Y H L F Y Q Y N P | - | leINV |
| 52 | - - - H R T R F H F Q P P K H W I N D P N A P M Y Y N G V Y H L F Y Q Y N P | - | lpINV |
| 113 | L M L S W Q R T S Y H F Q P V K N W M N D P N G P L Y Y K G W Y H L F Y Q Y N P | - | osINV |
| 101 | A M L S W Q R T A Y H F Q P Q K N W M N D P N G P L Y H K G W Y H L F Y Q Y N P | - | stINV |
| 4 | - - - - - | - | taINV(part) |
| 119 | A M L A W Q R T A F H F Q P P K N W M N D P N G P L Y H K G W Y H L F Y Q W N P | - | zmINV |
| site I | | | |
| 156 | K G D S W G - N I A W A H A V - S K D M I V N W R H L P L A M V P D Q W Y D S N G | - | faSST |
| 117 | Y G S A W D T T I S W A H A V - S K D M I H W L H L P I A M V P D H W Y D S K G | - | asSST |
| 117 | N G S A W D Y S I S W G H A V - S K D M I H W L H L P V A M V P D H W Y D S K G | - | acSST |
| 156 | S G S V W E P Q I V W G H A V - S K D L I H W R H L P P A L V P D Q W Y D I K G | - | taSST |
| 146 | Y G D S W G - N V S W G H A V - S K D L I V N W R H L P V A L V P D Q W Y D I N G | - | lpSST |
| 128 | Q S A I W G - N I T W G H S V - S K D M I N W F H L P F A M V P D H W Y D I E G | - | htSST |
| 137 | E S A I W G - N I T W G H S V - S K D M I N W F H L P F A M V P D Q W Y D I E G | - | csSST |
| 140 | E S A I W G - N I T W G H S V - S R D M I N W F H L P F A M V P D H W Y D I E G | - | ciSST |
| 132 | E S A I W G - N I T W G H S I - S R D M I N W F H L P F A M V P D H W Y D I E G | - | toSST |
| 184 | E G A V W G - N I A W G H A V - S R D L I V H W T H L P L A M V P D Q W Y D I N G | - | acINV |
| 158 | D A P V W G - K I V W G H A V - S K D L I I N W R H L P I A M E T D E W Y D E Q G | - | ciINV |
| 165 | D S A I W G - N I T W G H A V - S R D L I I N W L H L P F A M Q P D Q W Y D I N G | - | dcINV |
| 155 | N A A V W G - D I V W G H A V - S R D L I I H W V H L P I A M V A D Q W Y D S N G | - | atINV |
| 177 | A G A V W G - N I V W G H A V - S K D L I I R W K H L P I A M V A D R W Y D F N G | - | bvINV |
| 165 | D S A V W G - N I T W G H A V F P T D L I I N W I H L P F A M V P D Q W Y D V N G | - | ibINV |
| 138 | D S A I W G - N I T W G H A V - S K D L I I H W L Y L P F A M V P D Q W Y D I N G | - | leINV |
| 87 | K G S V W G - N I I W A H S V - S K D L I I N W I H L E P A I Y P S K K F D K Y G | - | lpINV |
| 153 | D S A V W G - N I T W G H A V - S T D L I I N W L H L P F A M V P D Q W Y D V N G | - | osINV |
| 141 | D S A I W G - N I T W G H A V - S K D L I I H W L Y L P F A M V P D Q W Y D I N G | - | stINV |
| 4 | - - - - - G H A V - S R D L I I H W R H L P L A M V P D Q W Y D I N G | - | taINV(part) |
| 159 | D S A V W G - N I T W G H A V - S R D L I I H W L H L P L A M V P D H P Y D A N G | - | zmINV |

| | | site II | | | |
|-----|-----------------|-------------|-------------------------|-----------------------------------|----------------|
| 194 | VLTGSITVLPDGQVI | L | LYTGNTDTL-AQVQCLATP | ADPSD faSST | |
| 156 | VWSGYATTLPDGRI | I | VLYTGGTDEL-VQVQNLAE | PADPSD asSST | |
| 156 | VWSGYATTLPDGRI | I | VLYTGGTDQL-VQVQNLAE | PADPSD acSST | |
| 195 | VLTGSITVLPDGKVI | L | LYTGNTETF-AQVTCLAEP | ADPSD taSST | |
| 184 | VLTGSITVLPDGRI | I | LYTGNTDTF-SQVQCLA | VPAQPADPSD lpSST | |
| 166 | VMTGSATVLPNGQI | I | MLYSGNAYDL-SQVQCLAY | AVNSSD htSST | |
| 175 | VMTGSATVLPDGQI | I | MLYTGNAYDL-SQLQCLAY | AVNSSD csSST | |
| 178 | VMTGSATVLPNGQI | I | MLYTGNAYDL-SQLQCLAY | AVNSSD ciSST | |
| 170 | VMTGSATMLPDGQI | I | MLYTGNAYDL-AQLQCLAY | AVNSSD toSST | |
| 222 | VWTGSATILPDGQI | VMLYTGTNES | VQVQNLAVPADQSD | aclINV | |
| 196 | VWTGSATILPNGELV | V | VLYTGSTNES-VQVQNLAY | YPADPSD cilINV | |
| 203 | VWTGSATILPDGKI | VMLYTGT | DTL-VQVQNLAYPANLSD | dclINV | |
| 193 | VWTGSATFLPDGSI | VMLYTGSTDKA | VQVQNLAYPEDPND | atINV | |
| 215 | VWTGSATILPDGQI | MMLYTGSTNES | VQVQNLAYPANLSD | bvINV | |
| 204 | VWTGSATILPDGRI | VMLYTGDTDDY | VQVQNLAFPANLSD | ibINV | |
| 176 | VWTGSATILPDGQI | MMLYTGDTDDY | VQVQNLAYPANLSD | leINV | |
| 125 | TWSGSSTILPNNKPV | I | YTGVVDSYNNQVQNYAIPANLSD | lpINV | |
| 191 | VWTGSATILPDGRI | VMLYTGDTDDY | VQDQNLAFPANLSD | osINV | |
| 179 | VWTGSATILPDGQI | MMLYTGDTDDY | VQVQNLAYPTNLS | D | |
| 32 | VWTGSATVLPDGSLV | I | LYTGNSTNAS-VQVQCLAVP | ADPSD taINV(part) | |
| 197 | VWSGSATRLPDGRI | VMLYTGSTAE | S-AQVQNLAE | PADASD zmINV | |
| | | site III | | | |
| 233 | PLLREWKKH | HPANPI | LYPPPGIGLKDFRDPL | TAWFDHS-D faSST | |
| 195 | PLLIEWKKS | SNHNPIL | MPPPPVGVP | HDFRDPLPVWYNES-D asSST | |
| 195 | PLLIEWKKS | SNGNPIL | MPPPPVGVP | HDFRDPLPVWYNES-D acSST | |
| 234 | PLLREWKKH | HPANPVVF | FFFFPGIGMKDFRDPTT | AWFDES-D taSST | |
| 223 | PLLRSWIKH | HPANPI | FFFFPGIGLKDFRDPL | TAWFEHS-D lpSST | |
| 205 | PLLIEWKKYE | GNPVL | FFFFPGIGYKDFRDPL | STLWSG-PD htSST | |
| 214 | PLLLDWKKYE | GNPNI | FFFFPGIGYKDFRDPL | STLWL G-PD csSST | |
| 217 | PLLLEWKKYE | GNPNI | FFFFPGIGYKDFRDPL | STLWMG-PD ciSST | |
| 209 | PLLLEWKKYE | GNPNI | FFFFPGIGYKDFRDPL | STLWRG-PD toSST | |
| 261 | TLLL | RWKKSEANPI | LVPPPGIGDKDFRDPTT | AWYEPS-D aclINV | |
| 235 | PLLICKWV | KYPGNPVL | VPPPGIDNKDFRDPTT | AWKT-P-E cilINV | |
| 242 | PLLLDWV | KYPDNPVM | FPPPGIGSTDFRDPTT | AWG-PD dclINV | |
| 232 | PLLWKWV | KFPGNPVL | VPPPGILPKDFRDPTT | AWKT-S-E atINV | |
| 254 | PLLLEWKV | KYPGNPVL | VPPPGIGKLDFRDPTT | AWL T-S-E bvINV | |
| 243 | PLLVDWV | KYPNPVI | VPPPGIGVKDFRDPTT | AWTA-GSQN ibINV | |
| 215 | PLLWDWV | KFKGNPVL | VPPPGIGVKDFRDPTT | AWT -GPQN leINV | |
| 165 | PFLRKWV | KPNNNPLI | VPDNSINRTEFRDPTT | AWMGQ-D lpINV | |
| 230 | PLLVDWV | KYPNPVI | VPPPGIGVKDFRDPTT | AWTA-GMQN osINV | |
| 218 | PLLWDWV | KYKGNPVL | VPPPGIGVKDFRDPTT | AWT -GPQN stINV | |
| 71 | SLLRNWT | KYEANPI | VPPPGIGDKDFRDPTT | AWFDES-D taINV(part) | |
| 237 | PLLREWV | KSDANPVL | VPPPGIGPTDFRDPTT | ACRTPAGND zmINV | |
| | | | | | |
| 271 | NTWRTVI | GSKDDDGHAGI | LSYKTKDFVNYEL | MPGNMHRG faSST | |
| 233 | SNWHLMI | GSKDDDN- | HYGTVLI | YLT KDFKTYTLLPEI LHKT asSST | |
| 233 | STWHMLI | GSKDDDN- | HYGTVLI | YTT KDFETYTLLPDILHKT acSST | |
| 272 | GTWRTI | I | GSKNDSDHSGIVFSYK | T KDFL SYEIMPGYMYRG taSST | |
| 261 | NTWRTI | I | GSKDDDGHAGIVLSYK | T DFTVNYELMPGNMHRG lpSST | |
| 242 | GEYRMVMGSKHNET | -I | GCALIYHTTNFTHFEL | KEEVLVHAV htSST | |
| 251 | GEYRMVMGSKHNET | -I | GCALIYHTTNFTHFEL | KEEVLVHAV csSST | |
| 254 | GEWRMVMGSKHNET | -I | GCALVYRTTNFTHFEL | NEEVLVHAV ciSST | |
| 246 | GDWIMI | MGSKHNQ | I | GCALVYRTSNFTHFEL | SEEPLHV toSST |
| 299 | DTWRTVI | GSKDSS- | HSGIAIVYSTKDFI | NYKLI PGLLH-A aclINV | |
| 272 | GKWRITI | T | GSKINKTT- | -GI SLYDTEDFKTFELLDGLLHVAV cilINV | |
| 279 | GKWRITI | T | GSKVNKT- | -GI SLYMYKTTDFITYELL | DNLHVAV dclINV |
| 269 | GKWRITI | T | GSKLNKT- | -GI SLYDFTDFKTYEKLDTLLHRV | atINV |
| 291 | GKWRITI | T | GSKINKT- | -GI SLYDFTDFKNYELLSNILHAV | bvINV |
| 282 | GQWLVTI | GSKVGKT | -GI SLYE | TTNFTRKLLDGVLHVAV ibINV | |
| 253 | GQWLLT | I | GSKIGKT | -GVALVYETSNTSFKLLDGVLHVAV leINV | |
| 202 | GLWRLTI | I | GSM-RKHRGMAL | LYRSRDFMKWKAQHPLHS-D lpINV | |
| 269 | GQRLVTI | GSKVGKT | -GI SLYE | TTNFTRKLLDGVLHVAV osINV | |
| 256 | GQWLLT | I | GSKIGKT | -GIALVYETSNTSFKLLDEVLVHAV stINV | |
| 109 | KTWRTSSAPRDNH | GHTGI | VMTYKTKDFINYELI | PGLLHSV taINV(part) | |
| 277 | TAWRVAI | GSKDRD- | HAGLALVYR | TEDFVRYDPAPALMH-A zmINV | |

site IV site V

| | | |
|-----|---|-------------|
| 311 | PDGTGMYECIDLYPVGG--NSSEMLG-----GDDSPDVL | faSST |
| 272 | KDNVGMLECVDLYPVATTGN-QI G--NGLEMQVGF GKGI K | asSST |
| 272 | KDSVGMLECVDLYPVATTGN-QI G--NGLEMKGGS GKGI K | acSST |
| 312 | PKGTGEYECIDLYAVGGGRKASDMYN-----STAEDVL | taSST |
| 301 | PDGTGMYECIDLYPVGG--NSSEMLG-----GDS SPEVL | lpSST |
| 281 | PH-TGMWECDL YPVSTVHT-----NGLDMVDN-GPNVK | htSST |
| 290 | PH-TGMWECDL YPVSTTHT-----NGLDMVDN-GPNVK | csSST |
| 293 | PH-TGMWECDL YPVSTTHT-----NGLDMKDGN-GPNVK | ciSST |
| 285 | PH-TGMWECDL YPVSTTHT-----NGLDMMDN-GPNVK | toSST |
| 337 | VERVGMWECDFYPVATADSSHAN-HGLDPSARPSPAVK | aciNV |
| 310 | PG-TGMWECDFYPPI SKQGE-----NGLDT SVD-GPGVK | cilNV |
| 317 | PG-TGMWECDFYPVSVTS-----NGLDT SVN-GPGVK | dclNV |
| 307 | PN-TGMWECDFYPVSKTAG-----NGLDT SVN-GPDVK | atlNV |
| 329 | QG-TGMWECDFYPVSVAEP-----NGLDT STN-DQSVK | bvINV |
| 320 | PG-TGMWECDL YPVSTTGE-----NGLDT SVN-GL DVK | ibINV |
| 291 | PG-TGMWECDFYPVSTKKT-----NGLDT SYN-GPGVK | leINV |
| 239 | STNTGNWECPDFFPVSLNST-----NGLDVSYR-GKNVK | lpINV |
| 307 | PG-TGMWECDL YPVSTTGE-----NGLDT SVN-GL DVK | osINV |
| 294 | PG-TGMWECDFYPVSTEKT-----NGLDT SYN-GPGVK | stINV |
| 149 | P-GTGMWECDFYPVGA-----DGSEEL | talNV(part) |
| 315 | VP GTGMWECDFYPVAAAGSGAAAAGSGDGLETSAAPGPGVK | zmiNV |

site VI

| | | |
|-----|--|-------------|
| 343 | FVLKESSDDERHDYYALGRFDAAANI WTP DQEL DL GI-- | faSST |
| 309 | HVLKASMDDERHDYYAI GTFDL ESFTWV PDDDTI DVGV-- | asSST |
| 309 | HVLKASMDDERHDYYAI GTFDL ESFSWV PDDDTI DVGV-- | acSST |
| 345 | YVLKESSSDDDRHDWYSLGRFDAAANKWTPI DEEEL EL GV-- | taSST |
| 333 | FVLKESANDERHDYYALGWFDAAANTWT PQDPEADL GI-- | lpSST |
| 313 | YVLKQSGDEDRHDWYAI GSYDI VNDKWKYPDDPEN DVG I-- | htSST |
| 322 | HVLKQSGDEDRHDWYAL GTYDVVNDKWKYPDDPEN DVG I-- | csSST |
| 325 | YILKQSGDEDRHDWYAVGTFDPEKDKWY PDDPEN DVG I-- | ciSST |
| 317 | YILKQSGDEDRHDWYAI GSFDPI NDKWKYPDDPEN DVG I-- | toSST |
| 375 | HVLKASMDDRHDYYAI GTYDPAQNTWV PDDASVDVG I-- | aciNV |
| 342 | HVVKASMDDRNDYYAI GTYDAYKGKWT PDNP TLDVG I-- | cilNV |
| 349 | HVLKSSLDDDRHDYYAL GTYDPI NDKWT PDNP ELDCGI-- | dclNV |
| 339 | HI VKASMDDT RFDHYAVGTYFDSNGTW PDDPTI DVGMT A | atlNV |
| 361 | HVLKASMDDRNDYYTL GTYI EDNVTW PDNP AI DVGI-- | bvINV |
| 352 | HVLKASLDDD KHDYYAL GTYDPAK NKKWTPDNT DLDVG I-- | ibINV |
| 323 | HVLKASLDDNKQDH YAI GTYDL GKKWTPDNP ELDCGI-- | leINV |
| 272 | YVLKNSLDVARFDYYTI GMYHTKI DRYI PNNSI DG-- WK | lpINV |
| 339 | HVLKTSLDDDKHDYYAL GTYDPVKWKWTPDNP DLDVG I-- | osINV |
| 326 | HVLKASLDDNKQDH YAI GTYDLTKNKTCPDNP ELDCGI-- | stINV |
| 172 | YVMKESSSDDDRHDWYALGRYDAAANKYTPI DAEMDVGI-- | talNV(part) |
| 355 | HVLKASLDDDKHDYYAI GTYDPAT DTWT PDSAED DVG I-- | zmiNV |

site VII

| | | |
|-----|--|-------------|
| 381 | GL RYDWGKY YASKSFYDQKKNRRI VWAYI GETDS-EQADI | faSST |
| 347 | GL RYDYGKFYASKTFYDQEKRRI L WG YVGEVDS-KTDDA | asSST |
| 347 | GL RYDYGKFYASKTFYDQEKKRRI L WG YVGEVDS-KADDI | acSST |
| 383 | GL RYDWGKY YASKSFYDPVKRRVVWAYVGETDS-ERADI | taSST |
| 371 | GL RYDWGKY YASKSFYDPI KNR RVV WA FVGETDS-EQADK | lpSST |
| 351 | GL RYDFGKFYASKTFYDQHKKRRLVWG YVGETDP-QKYDL | htSST |
| 360 | GL RYDFGKFYASKTFYDQHKKRRLVWG YVGETDP-PKYDV | csSST |
| 363 | GL RYDYGKFYASKTFYDQHKKRRLVWG YVGETDP-PKS DL | ciSST |
| 355 | GL RYDGKFYASKTFYDQHKS RRVLWG YVGETDP-PKDDL | toSST |
| 413 | GL RYDWGKFYASKTFYDHAKKRI L WSWI GETDS-ETADI | aciNV |
| 380 | GL RYDYGI Y YASKTFYDQNK QRRVLWSWI KETDT-EASDI | cilNV |
| 387 | GL RL DYGKY YASKTFYDQDKERRRLWGWIGESDN-ESTDL | dclNV |
| 379 | SL RYDYGKFYASKSFYDQNK QRRVLWSWI GESDS-EASDV | atlNV |
| 399 | GL RYDYGRFYASKTFYDHEKKRI L WGWI TEGDS-EAADV | bvINV |
| 390 | GL RL DYGKY YASKTFYDQNK QRRRI L WGWI GETDL-EAVDL | ibINV |
| 361 | GL RL DYGKY YASKTFYDPKKERRVLWGWI GETDS-ESADL | leINV |
| 310 | GL RI DYGNFYASKTFYDPSRNRRVI WGWSNESDVL PDDDI | lpINV |
| 377 | GL RL DYGKY YASKTFYDQNK QRRRI L WGWI GETDL-EAVDL | osINV |
| 364 | GL KL DYGKY YASKTFYDPKKERRVLWGWI GETDS-ESADL | stINV |
| 210 | GL RYDWGKFYASKTFYDPSKNRRVLWGWI GETDS-ERADV | talNV(part) |
| 393 | GL RYDYGKY YASKTFYDPVL RRRVLWGWI GETDS-ERADI | zmiNV |

site VIII

| | | |
|-----|---|-------------|
| 420 | T K G W A N L M T I P R T V E L D K K T R T N L I Q W P V E E L D T L R R N S - | faSST |
| 386 | R K G W A N V L N I A R T I L F D V K T R S N L L V W P V E E L D A L R T S S - | asSST |
| 386 | L K G W A S V Q N I A R T I L F D A K T R S N L L V W P V E E L D A L R T S G - | acSST |
| 422 | T K G W A N L Q S I P R T V E L D K K T R T N L I V Q W P V E E L D A L R I N T - | taSST |
| 410 | A K G W A S L M S I P R T V E L D K K T R T N L I Q W P V E E I E T L R R N V - | lpSST |
| 390 | S K G W A N I L N I P R T V V L D L E T K T N L I Q W P I E E T E N L R S K K Y | htSST |
| 399 | Y K G W A N I L N I P R T I V L D T K T N T N L I Q W P I A E V E N L R S N K Y | csSST |
| 402 | L K G W A N I L N I P R S V V L D T Q T G T N L I Q W P I E E V E K L R S T K Y | ciSST |
| 394 | L K G W A N M L N I P R T I V L D T V T G T N L I Q W P I D E V E N L R S K K Y | toSST |
| 452 | A K G W A S L Q G V P R T V L L D V K T G S N L I T W P V V E I E S L R T R P - | acINV |
| 419 | K K G W A S L M G V P R T I V L D K K T Q S N I I Q W P V E E I N L L R T N L - | ciINV |
| 426 | L K G W A S V Q S I P R T V V V F D K K T G T N I L Q W P V K E V E S L R S R S - | dcINV |
| 418 | Q K G W S S L Q G I P R T V V L D T K T G K N L V Q W P V E E I K S L R L S S - | atINV |
| 438 | K K G W A S L Q G I P R T V L F D Q K T R T N L V Q W P V E E V E T L R Q N N - | bvINV |
| 429 | M K G W A S L Q A I P R T I V F D K K T G T N V L Q W P V D E V E S L R S G D - | ibINV |
| 400 | Q K G W A S V Q S I P R T V L Y D K K T G T H L L Q W P V E E I E S L R V G D - | leINV |
| 350 | K K G W A G I Q G I P R Q V W L D L - S G K Q L V Q W P I E E L E T L R K Q K - | lpINV |
| 416 | M K G W A S L Q A I P R T I V F D K K T G T N V L Q R P E E E V E S W S G D - | osINV |
| 403 | Q K G W A S V Q S I P R T V L Y D K K T G T H L L Q W P V E E I E S L R G G D - | stINV |
| 249 | A K G W A S L Q S I P R T V E L D E K T R T N L I Q W P V V E I E T L R I N S - | taINV(part) |
| 432 | L K G W A S V Q S I P R T V L L D T K T G S N L L Q W P V V E V E N L R M S G - | zmINV |
| 459 | T D L S G I T V D A G S V I R L P L H Q G A Q I D I E A S F Q L N S S D V D A L | faSST |
| 425 | K E F N G V V V E P G F T Y H L D V G T A S Q L D I E A E F E I N Q E A V D A V | asSST |
| 425 | K E F N G V V V E P G S T Y H L D V G T A T Q L D I E A E F E I N K E A V D A V | acSST |
| 461 | T D L S G I T V G A G S V A F L P L H Q T A Q L D I E A T F R I D A S A I E A L | taSST |
| 449 | T D L G G I T V E A G S V I H L P L Q Q G G Q L D I E A S F R L N S S D I D A L | lpSST |
| 430 | D E F K D V E L R P G A L V P L E I G T A T Q L D I V A T F E I D Q K M L E S T | htSST |
| 439 | N E F K D V E L K P G S L I P L E I G T A T Q L D I T A T F E V D Q T M L E S T | csSST |
| 442 | D E F K D V E L R P G S L V P L E I G T A T Q L D I S A T F E I D Q K K L Q S T | ciSST |
| 434 | D E F K D V E L R P G S I I P L E I G S A T Q L D I M A T F E I D E K M L E S T | toSST |
| 491 | R D F S G I T V D A G S T F K L D V G G A A Q L D I E A E F K I S S E E L E A V | acINV |
| 458 | T V F K T V V V E S G S L V P L N L P S A S Q L D I V A E F E V D K K T V E R L | ciINV |
| 465 | Y E I N D V E L K P G S L V P L K I S S A A Q L D I V A S F E V D E E E A F K R T | dcINV |
| 457 | K Q F D - L E V G P G S V V P V D V G S A A Q L D I E A E F E I N K E S L D K I | atINV |
| 477 | K D F D K V E V P A G S V V P L D V S A A T E I D I I A E F D I D K E A L E N L | bvINV |
| 468 | P I T A E A N L E P G S V V P I H V S E G T Q L D I T A S F E V D E T L L E T T | ibINV |
| 439 | P T V K Q V D L Q P G S I E L L R V D S A A E L D I E A S F E V D K V A L Q G I | leINV |
| 388 | V Q L N N K K L S K G E M E F V K G I S A S Q A D V E V L F S F S S - L N K A | lpINV |
| 455 | P I T Q R R I F E P G S V V P I H V S G A T Q L D I T A S F E V D E T L L E T T | osINV |
| 442 | P I V K Q V N L Q P G S I E L L H V D S A A E L D I E A S F E V D K V A L Q G I | stINV |
| 288 | T D L G G T T I D T G S V L P L P L R R A T Q L D I E A T F H L D T S A I A A V | taINV(part) |
| 471 | K S F D G V A L D R G S V V P L D V G K A T Q L D I E A V F E V D A S D A A G V | zmINV |
| 499 | T E A D V - - - - - S Y N C S T S - G A A V R G A L G P F G L L V L A N - G R | faSST |
| 465 | V E A D V - - - - - T Y N C S T S D G S A H R G L L G P F G L L V L A N E K M | asSST |
| 465 | V E A D V - - - - - T Y N C S T S D G A A H R G L L G P F G L L V L A N E K M | acSST |
| 501 | N E A D V - - - - - S Y N C T T S S G A A T R G A L G P F G L L V L A N R A L | taSST |
| 489 | N E A D V - - - - - G F N C S S S D G A A V R G A L G P F G L L V F A D - G R | lpSST |
| 470 | L E A D V L - - - - - F N C T T S E G S V A R S V L G P F G V V V L A D A Q R | htSST |
| 479 | L E A D V L - - - - - F N C T T S E G S A G R G V L G P F G L V V L A D A E R | csSST |
| 482 | L E A D V L - - - - - F N C T T S E G S V G R G V L G P F G I V V L A D A N R | ciSST |
| 474 | L E A D V L - - - - - F N C T T S E G S V G R G V L G P F G I V V L A D A K R | toSST |
| 531 | K E A D V - - - - - S Y N C S S S G G A A E R G V L G P F G L L V L A N Q D L | acINV |
| 498 | N G A D - - - - - I A Y D C A K N G G A A Q R G A L G P F G F S V L A H E G L | ciINV |
| 505 | Y E A D - A - - - - S Y N C T A S E G A A G R G I L G P F G I L V L A D D P L | dcINV |
| 496 | I G N A S V V A E A E E F S C E K S G G S T V R G A L G P F G F S V L A T E S L | atINV |
| 517 | P V S E - - - - - E H Y S C P A S K G A A Q R G A L G P F G L L V L A N N D L | bvINV |
| 508 | S E S H D A - - - - - G Y D C S N S G G A V T R G S L G P F G L L V V A D E K L | ibINV |
| 479 | I E A D H V - - - - - G F S C S T S G G A A S R G I L G P F G V I V I A D Q T L | leINV |
| 426 | E Q F D P R W A D L Y A Q D V C A I K G S T I Q G G L G P F G L A T L A S K N L | lpINV |
| 495 | S E S H D A - - - - - G Y D C S N S G G A G T R G S L G P F G L L V V A D E K L | osINV |
| 482 | I E A D H V - - - - - G F S C S T S G G A A S R G I L G P F G V V V I A D Q K L | stINV |
| 328 | N E A D V - - - - - G Y N C S T S G G A A N R G A L G P F G L L V L A D G A L | taINV(part) |
| 511 | T E A D V - - - - - T F N C S T S A G A A G R G L L G P F G L L V L A D D D L | zmINV |

| | | |
|-----|---|-------------|
| 531 | T EQT A V Y F Y V S K G V D G A L Q T H F C H D E S R S T Q - - A K D V V N R | faSST |
| 499 | T E K T A T Y F Y V S R T V D G G L Q T H F C Q D E L R S S K - - A N D I T K R | asSST |
| 499 | T E K T A T Y F Y V S R N V D G G L Q T H F C Q D E L R S S K - - A N D I T K R | acSST |
| 535 | T E Q T G V Y F Y V S K G L D G G L R T H F C H D E L R S S H - - A S D V V K R | taSST |
| 522 | H E Q T A A Y F Y V S K G L D G S L L T H Y C H D E S R S T R - - A K D V V S R | lpSST |
| 504 | S E Q L P V Y F Y I A K D I D G T S R T Y F C A D E T R S S K - - D V S V G K W | htSST |
| 513 | S E Q L P V Y F Y I A K D T D G S S K T Y F C A D E S R S S N - - D V D I G K W | csSST |
| 516 | S E Q L P V Y F Y I A K D T D G T S K T Y F C A D E S R S S T - - D K D V G K W | ciSST |
| 508 | S E Q L P V Y F Y I A K N T D G S S K T Y F C A D E S R S S M - - D K S V G K W | toSST |
| 565 | T E Q T A T Y F Y V S R G M D G G L N T H F C Q D E K R S S K - - A S D I V K R | aclINV |
| 532 | A E H T P V Y F Y V A K G V D G N L Q T F F C A D Q S R S S N - - A N D V D K S | cilINV |
| 539 | S E L T P V Y F Y I A K G V D G N A K T Y F C A D Q S R S S T - - A S D V D K E | dclINV |
| 536 | S E Q T P V Y F Y V A K G K D S E L K T F F C T D T S R S S V - - A N D V V K P | atINV |
| 551 | A E Q T P V Y F Y V I K T L S G S F K T F F C T D L S R S S A - - A T D V F K N | bvINV |
| 543 | S E L T P V Y F Y V A K G A D G K A K A H F C A D Q T R S S M - - A S G V E K E | ibINV |
| 514 | S E L T P V Y F Y I S K G A D G R A E T H F C A D Q T R - - - - - - - - - - l e l N V | |
| 466 | E E Y T P V F F R V F K A - Q K N Y K I L M C S D A R R S T M R Q N E A M Y K P | lpINV |
| 530 | S E L T P V Y L Y V A K G G D G K A K A H L C A Y Q T R S S M - - A S G V E K E | oslINV |
| 517 | S D V T P V Y F Y I S K G A D G R A E T H F C A D Q T R S S E - - A P G V A K Q | stlINV |
| 362 | K E Q T A V Y F Y V S R G L D G G L Q T H F C Q D E S R S S L - - A Q D V V K R | taINV(part) |
| 545 | S E Q T A V Y F Y I L L K G T D G S L Q T F F C Q D E L R A S K - - A N D L V K R | zmlINV |
| 569 | M I G S I V P V - - L D G E T F S V R V L V D H S I V Q S F A M G G R I T A T S | faSST |
| 537 | V V G H T V P V - - L H G E T F S L R I L V D H S I V E S F A Q K G R A V A T S | asSST |
| 537 | V V G H T V P V - - L H G E T F S L R I L V D H S I V E S F A Q K G R A V A T S | acSST |
| 573 | V V G S T V P V - - L D G E D F S V R V L V D H S I V Q S F A M G G R L T A T S | taSST |
| 560 | V V G G T V P V - - L D G E T F S V R V L V D H S I V Q S F V M G G R T T V T S | lpSST |
| 542 | V Y G S S V P V - - L P G E K Y N M R L L V D H S I V E G F A Q N G R T V V T S | htSST |
| 551 | V Y G S S V P V - - L E G E K F N M R L L V D H S I V E G F A Q G G R T V V T S | csSST |
| 554 | V Y G S S V P V - - L G G E N Y N M R L L V D H S I V E G F A Q G G R T V V T S | ciSST |
| 546 | V Y G D S V P V - - L E G E K H N M R L L V D H S I V E G F A Q G G R T V V T S | toSST |
| 603 | I V G H S V P V - - L D G E S F A L R I L V D H S I V E S F A Q G G R A S A T S | aclINV |
| 570 | I Y G S I V P V - - L K G E K L A M R I L V D H S I V E S F A Q E G R T C I T S | cilINV |
| 577 | V Y G S D V P V - - L P G E S L S M R L L V D H S I V E S F A Q G G R T V I T S | dclINV |
| 574 | I Y G S V V P V - - L K G E K L T M R I L V D H S I V E A F G Q G G R T C I T S | atINV |
| 589 | I Y G S T V P V - - L K G E K L S M R I L V D H S I V E A F A Q G G R T C I T S | bvINV |
| 581 | V Y G S A V P V - - L D G E N Y S A R I L I D H S I V E S F A Q G G R T - V T E | ibINV |
| 542 | - l e l N V | |
| 505 | S F A G Y V D V D L V D M K K L S L R S L I D H S V V E S F G A G G K T C I T S | lpINV |
| 568 | V Y G S A V P V - - L D G E N Y S A R I L I D H S I V E S F A Q A G R T C V R S | oslINV |
| 555 | V Y G S S V P V - - L D G E K H S M R L L V D H S I V E S F A Q G G R T V I T S | stlINV |
| 400 | V V G F T V P V - - L D G E D L S L R V L V D H S I V E S F A M G G R S T A N I | taINV(part) |
| 583 | V Y G S L V P V - - L D G E N L S V R I L V D H S I V E S F A Q G G R T C I T S | zmlINV |
| 607 | R A Y P T E A I Y A - A A G V Y L F N N A T G A T V T A E R L V V Y E M A S A D | faSST |
| 575 | R V Y P T E A I F D - S T R I F L F N N A T S A T L T A K S V K I W H M N S T H | asSST |
| 575 | R V Y P T E A I Y D - S T R V F L F N N A T S A T V T A K S V K I W H M N S T H | acSST |
| 611 | R A Y P T E A I Y A - A A G V Y L F N N A T G T S V T A E K L V V H D M D S S Y | taSST |
| 598 | R A Y P T E A I Y A - A A G V Y L F N N A T S A T I T A E G L V M Y E M A S A E | lpSST |
| 580 | R V Y P T K A I Y - N A A K V F L F N N A T G I S V K A - S L K I W K M G E A E | htSST |
| 589 | R V Y P A K A I Y - G A A K L F L F N N A T G I S V K A - S L K I W K M K E A Q | csSST |
| 592 | R V Y P T K A I Y - G A A K I F L F N N A T G I S V K V - S L K I W K M A E A Q | ciSST |
| 584 | R V Y P T K A I Y - G A A K L F L F N N A T G I S V K A - S L K I W K M A E A Q | toSST |
| 641 | R V Y P T E A I Y N - N A R V F V F N N A T G A K V T A Q S L K V W H M S T A I | aclINV |
| 608 | R V Y P T K A I N N N A - Q L F L F N N A T A T K V T A - S V N V W Q M N S A H | cilINV |
| 615 | R V Y P T R A I Y - S A A R V F L F N N A T G V S V T A - S V K A W Q M N S A T | dclINV |
| 612 | R V Y P T T A I Y G A A - K L F L F N N A L D A T V T A - S F T V W Q M N S A F | atINV |
| 627 | R V Y P T K A I Y K E T - K L Y V F N N A T T A T V T A - S I K T W Q M S S A R | bvINV |
| 618 | R V Y P T S F I L Q G S L R V S L F R - - M R A - - - - - - - - - - - - - - - - ibINV | |
| 542 | - - - - - - F A F - - - - - - L S G - T I N L - - - - - - - - - - l e l N V | |
| 545 | R V Y P S L A I Y D N A - H L F V F N N G S E - T I T I E T L N A W S M G A C K | lpINV |
| 606 | R D Y P T K D I Y - G A A R C F F F N N A T E A S V R A - S L K A W Q M K S F - | oslINV |
| 593 | R I Y P T K A V - N G A A R L F V F N N R T G A S V T A - S V K I W S L E S A N | stlINV |
| 438 | E G V S D G G G H L R - R R W R V P F Q Q R H R R C - - - - R H R G E A R G A R D | taINV(part) |
| 621 | R V Y P T R A I Y D - S A R V F L F N N A T H A H V K A K S V K I W Q L N S A Y | zmlINV |

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|-----|--|-------------|
| 646 | NH FTNDL - . MKPSRALVAFMVTGDRPCLHI - HWQKK | faSST |
| 614 | NHPF - PGFPFP | asSST |
| 614 | NHPF - PGFPAP | acSST |
| 650 | NH YTDDDLVVV - - - - - - - - - - D | taSST |
| 637 | SRAFLAD - DM | lpSST |
| 618 | LNPFP - - - - - LPGWTFEL | htSST |
| 627 | LDPFP - - - - - LSGWSSSD | csSST |
| 630 | LDPFP - - - - - LSGWS S - - CAAC | ciSST |
| 622 | LDPFP - - - - - LSGWS STTTCAAC | toSST |
| 680 | NEI YDPATSVM | aciINV |
| 646 | V | cilINV |
| 653 | LKPFP - - - - - FDQ - - - L | dclINV |
| 650 | IHPYS - - - - - DEAVRALSR | atlINV |
| 665 | LQ - - - - - ENI EETKER | bvINV |
| 645 | ITFL - - - - - FLS - - LII S | ibINV |
| 552 | - - - S - - - - LSS - - - V | leINV |
| 583 | MN | lpINV |
| 643 | IRPYP - - - - - FIP - DQKSMA | osINV |
| 631 | IRSF - - - - - LQD - - - L | stINV |
| 473 | GRL LQPDLHGRRCL SRL VAAI NQAL GPVMHI HPYYI L | taINV(part) |
| 660 | IRPYPAT TSL | zmiINV |

Supplementary figure S1

Alignment of 1-SSTs and vacuolar invertases from different plants as we used it to identify conserved replacements. Amino acids identical to aciINV are shaded black, those identical to faSST are shaded grey. The position of mutations at sites I to VIII is indicated by red boxes. See materials and methods for accession numbers.