



**HAL**  
open science

## **ABCC1, an ATP Binding Cassette Protein from Grape Berry, Transports Anthocyanidin 3-O-Glucosides**

Rita Maria Francisco, Ana Regalado, Agnes Ageorges, Bo J. Burla, Barbara Bassin, Cornelia Eisenach, Olfa Zarrouk, Sandrine Vialet, Therese Marlin, Maria Manuela Chaves, et al.

► **To cite this version:**

Rita Maria Francisco, Ana Regalado, Agnes Ageorges, Bo J. Burla, Barbara Bassin, et al.. ABCC1, an ATP Binding Cassette Protein from Grape Berry, Transports Anthocyanidin 3-O-Glucosides. *The Plant cell*, 2013, 25 (5), pp.1840 - 1854. 10.1105/tpc.112.102152 . hal-01837678

**HAL Id: hal-01837678**

**<https://hal.science/hal-01837678>**

Submitted on 29 May 2020

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

**Supplemental Data. Francisco et al. (2013). Plant Cell 10.1105/tpc.112.102152**

**Supplemental Data Set 1. FASTA file of amino acid sequences of *Vitis vinifera* ABCCs used for the construction of the phylogenetic tree.**

>VvABCC1

MGDLWTMFCGEPSCLDSSGCSSEFIFFNHPSSCANHALTVCFDILLFVMFLFTMIQRTSSKPVHVPQQFQRFSPQLQIS  
SAIFNGCLGLVYLCLGVWILEENLRKTQIVLPLHWWLLPLLQGF TWLLVGLMVSLRGQYLPRSPRLRILSILAF LFSGI  
TGVLSIFSAIVYKEASVEIVLVLSLPGAILLLLCA YKGYKYEETDKIVNGSGLYTPLNGEADGSAKTDSVGDVTPFA  
KAGFFSSMSFWWLNPLMKRGTKKTLENE DIPKLREEDRAESCYLQFLEELIKQKQIEPSSQPSILRVII LCYWKDIFI  
SGFFALVKILTSTGPLLLNAFIKVAEGKELFKN EGYVLAMALLVSKNVESLSQRQWYFRSRLIGLRVRSLLTAAIYK  
KQLRLSNAAKMIHSSGEITNYVTVD SYRIGEFPPFWHQ TWTTSLQLCIVLVILFNILGLATFAALVVIILTVLCNAPL  
AKLQHKFQSKLMVAQDERLRACSEALVNMKVLKLYAWENHFKNVIEKLRNVEYKWLSGVQLRKGYNGFLFWSSPVLVS  
AATFGACFFLGIPLNASNVFTFVAALRLVQDP IRSIPDVIGVVIQAKVAFARIVKFL EAPQLQTSNVRQKSN IENISN  
AISIKSANFSWEEKLSKSTLRDISLEVRTGEKVAICGEVGSKSTLLAAILGEIPDVQGTIRVYGR IAYVSQTAWIQT  
GSIQENTILFGSSMDPERYQATLEKCSLVKDL DLPYGDLTEIGERGVNLSGGQKQRIQLARALYQDADIYLLDDPFSA  
VDAHTATSLFNEYVMDALSGKTVLLVTHQVDFLPAFDSVLLMSDGEIIQAAPYQQLLVSSQEFVDLVNAHKETAGSER  
LAEVTPEKFENS VREINKTYTEKQFKAPSGDQLIKQEEREIGDMGFKPYMQYLSQNKGYLFFSLAALSHILFVAGQIS  
QNSWMAANVDNPNISTLQLIVVYLLIGATSTL FLLSRALFVVALGLQSSKSLFTQLLNSLFRAPMSFYDSTPLGRILS  
RISNDLSIVDLDPFVFAFGATTNAYSNLGVLAVVTWQVPFVSIPMIYVAIRLQRYYFASAKELMRINGTTKSLVA  
NH LAESIAGAMTIRAFEEEEERFFVKNMDFIDTNASPFFHSFAANEWL IQRLEALSAMVLSSSALCMILLPPGTF TAGF  
IGMAMSYGLSLNMSLVFSIQNQCILANYIISVERLNQYMHIPSEAPEVIEGSRPPPNWPAVGRVDI HDLQIRYRPDTP  
LVLRGINCTFEGGHKIGIVGRTGSGKTTLIGALFRLVEPAGGKIIVDGDIDISTIGLHDLRSHFGIIPQDPTLFNGTVR  
YNLDPLSQHTDHEIWEVLGKCQLQEAVQEKEEGLGSIVAEGGSNWSMGQRQLFCLGRALLRRSRILVLDEATASIDNA  
TDLILQKTI RTEFADCTVITVAHRIPTVMDCTMVLAISDGKLV EYDEPAKLMKREGSLFGQLVREYWSHFHSAESH

>VvABCC2

MGDLWTLFCGESNCSDTGRR TSSFSFAV FASPSSCINHAFVLCFDILLAMFVS NMIQKALS KRVRIPPRFQ  
GFSPLQIISAVFNGCLGSVYLSLGIWILEEKLRKTHSVFPLHWWILLFFHGFTWLILALIVSLWGRHLSKAP  
FRVLSIFAFLLAGTICVFLSPAIVNKEVSLKTTLDVLSFPGASLLIACVFKDYKDD ESEETVNGSGLYTPL  
KEETPGNSEADSGSFATPFATAGFFSRMFFWLNPLMRKGTEKILEEEDIPKLREVDQAKNCYLQFLEQLHK  
QQNQTL SHASILRTIISCHWKEIFISGFFALLK TLSLLTGPLLLKAFVEVAEDQKNFTFEGCVLALS LFFG  
KTIESL SERQWYFRSRITGMRV RSTLTAVIYKQLRLSNAAKMVHSPGEITNYVTVDAYRIGEFPPFWHQ TW  
TTILQLCVALLFQAVGFATVAAMVIVLTVLCNVPLAKLQHLQTKFMAAQAQRVKASSEALVNMKVLKL  
YAWETHFENVIEALRNVELKCLSRVQLLKAYSFV FYASPI LISGATFGACYFLGVPLYASNVFTFIATLRL  
VQDPVRFIPDVIGVVIQAKIAFSRIVQFLEAPELHSGNVKKN SMEIVDHSILINSANFSWDESLELTLRS  
INLEVRPGEKVAICGEVGSKSTLLAAILGEVPNTQGTIQVRGKIAYVSQTAWIQTGTIQENILFGSEMDTQ  
RYHEALESSSLVKDLEMFPHGELTEIGERGVNLSGGQKQRIQLARALYQDADIYLLDDPFSAVDAHTATSL L  
NEYVMRALSGKTVLLVTHQVDFLPAFGSVLLMSD GKILHAAPYHQLLTSSQEFQDFVNAHQQTAGSERL TEV  
ALPRRCETSTGEIKRTHIEREFNASGHDQLIKQEEREIGNPGFKPYMLYLNQNKQFWLFP IGVLCNIVFSVG  
LTLQNVW MATNVENS NVSTSQLIVVYLSIGCTSTVFLLCRTLLMVSLGLQSSKSLLAQLLNSFFRAPMSFYD  
STPLGRMISRVSDDLNIIDL DLLFGIVYTVSSTA AVCVILGVLA AVTWQVLLVSIPTIYLAMRLQKYYYASA  
KEMMRINGTTKSLVANHLAESVAGAMVIRAF EQEDRFFAKILHLIDTNASPFFHAFANA EWL IQWLVTL SAT  
ILSSSALCMVLLPKGTCSPGFIGMALS YGLSLNLSLVNSTRNICTLENYIISVERLNQYMHIPSEAPEVIHN  
NRPPPNWPDVGKVEIQKLQIRYRPNLPLVLRGIDCIFE GGHKIGIVGRTGSGKTTLISALFRLVEPAGGRII  
VDGLDISMIGLHDLRSRFGIIPQDPTLFNGTVRYNLDPLSQHTEQEIWEVLAKCQLQETVQDKEEGLDSMVV  
EDGSNWSMGQRQLFCLGRALLRRSRILVLDEATASIDNATDLILQKTI RTEFANCTVITVAHRIPTVMDCTM  
VLAISDGKLV EYDKPTDLMKKEGSLFGQLVKEYWSHFH SADS Y

>VvABCC3

MVFFRFLRWGALMDSSLGLINVAFFWLLL TWVLVGLRKR RDGGGADSENEPTMRKSTVFTVSVLSNAII  
CVSHLGFCLYEFWSLETINLVHIFSAMTWLAAIITVSCFRNSTTRENKRWPLILTSWVVFSSILSSLSVSV  
YLVTRLKILTLPDFWPDFVQPATIDDFASLIPLWILLCFNVLPFNCGKKRSDLEHPLLESEGGNLSHGVDPY  
SSAGIWSKLTFLWLNPLFRKGRVQKIQLHHIPPVPQSEKAETASSLLEETLTKQKTSVTKALFCSVWRSLAI  
NAVFAGANTIASYMGPFLLITHFVNFLSGKGDDSSYYGLVLALIFFMAKTLESLSQRQWYLGGRIGIRVRA  
ALMVLVYKKSLSIKYAGSNSGKIINLINVVDVDRIGDFCLCIHGVWLLPVQVGLALVILYRNLGAAPSMTALF  
ATVLMVGNTP LAKRQERLH SKIMEAKDSRIKATSETLKS MRVLKLSWEDTFLNKIKELRETERHWL KRYL

YTCSAVAFWFWSPTLVSVITFAVCIVLKTPLTTGRVLSALATFRILQEPIYNLPELISMAIQTKVSMNRIQ  
LFIQEEDQKKLATYPTSESSEVSIDIEVGEYAWTCDENLKPITIKIDQRMIIMKGYKVAVCGSVGSGKSSLLC  
SILGEIPRISGTGSKVYGSKAYVPQSAWIQTGTIRDNVLFGEINKAFYEDVLEACALDRDIQLWYNGDLSV  
VGERGMNLSGGQKQRIQLARAIYSESDVYFLDDPFSAVDAHTGAHLFQKCLMQILSQKTVIYVTHQLEFLDA  
SDLVLMKDGIIIVQSGKYEDLIADPNSELVRQMTAHNKSQVNPSPQENCFTNKPPQKKKIDLIEENSHDPI  
SNGKLLDGIHKEETESGRVKWHVYSTFITSAYKGGVLPVILLCQVLFQGLQMGSNYWIAWATEEEGRVSREQ  
LIGVFSLLSGGSSIFILGRAVLLSTIAIETARHLFSEMIKAVFRAPVSFFDSTPSSQILNRSSTDQSTVDTD  
IPYRLAGLAFALIQLLSIIIVLMSQVAWQVFLLFVLSILAIISIWIYQAYYIATARELARMVGVKAPILHHFSES  
VAGAATIRCFSQDDRFLRRNLSLIDDYSRVAFHNTATMEWLCVRINFLFNLVFFLVLVILVSLPRSAISPSL  
AGLAATYGLNLNLQAWVIWNLNENKMSVERILQFTKIPSEAPLVIENCRPSLEWPSNGRIDLDNLHVR  
YPTPLPMVLKGITCTFPGERKIGVVGRTGSGKSTLIQALFRVVEPSEGQILIDGVDISKMGLKDLRSLSII  
PQDPTLFQGTMRNLDPLGEHSDQEIWEVLNKCRLAEIIGQDKGLLNARVAEDGENWSVGQRQLVCLARVLL  
QRRKILVLDEATASVDTATDNLIQKTIREETSKCTVITVAHRIPTVIDNDLVVLDEGKVVVEYDSPQLLKD  
SSSAFSLVMEFRRRSSKSSSS

>VvABCC4

MSSASWITTLSCSSSVIASSGETPFSLLIQWLRIFLSPCQRALLSSIDLFLFLLTIAFSVQKLYSRFISN  
GRSSSAINKPLIRNNRRLRRTLLWFKLTLTATALLAVCHGFLCILAFARGAQMPWKLIDALFWLVEAITHFL  
ITILIAHGKRFQAVTYPLSLRIFWVVSFISSLFTTSGIIRIFFVEGFEASNRLDDIVTLVTFPLSVLLL  
VGIRGSTGITVDRESEPMVDEEKLYPELLGKSNVTGFASASILSKALWLMNPLLKGYKSPLKIDEIPSL  
SPEHRAERMSELFESNWPKPHEKLNHPVRTTLFRCFWREVAFTAFLAIVRLCVIYVGPLLIQRFVDFTSGKR  
SSPYEGYYLVILLIAKTVEVLTSHHFNFNSQKLGMLIRSTLITSLYRKGLRLSCSARQDHGQVIVNYMAV  
DAQQLSDMMLQLHAIWLMPLQVTVALVLLYNELGGAMITAVIGIFAVLLFVLMGTRRRNRFQHNVMKNRDLR  
MKATNEMLNYMRVIKQFAWEHFNKRIQSFRESEFGWLTKFMYSISGNIIVMWSTPLMISAFTFATAIMLG  
QLDAGTVFTTTSIFKILQEPHAFQSMISISQAMISLARLDKYMTSRELVESSVEREESCDGRIAVEVKDG  
VFSWDDEGKEEVLRLNFEIKKGELAAIVGTGSGKSSLASVLEMHKISGQVRLCGTTAYVAQTSWIQNG  
TIQENILFGLPMNTEKIRVIRVCCLEKDLMEYGDQTEIGERINLGGQKQRIQLARAVYQDCDVFLLD  
DVFSAVDAHTGTDIFKECVRGALRNKTIILLVTHQVDFLHNVDLILVMRDGMIVQSGKYNDLLESGMDFKALV  
AAHETSMELVEEAGPAITSENPKLPQSPQPFNSHGEANGVDKSGDQSKSNKESKLIKDEERETGKVSFQV  
YKQYCTEAYGWSGLAGVLLLSLAWQGSMLASDYWLAYETSEKHAKSFNASLFTNYSIIAAVSVLLIVIRSF  
TVTKLGLKTAQIFFSQILHSLHAPMSFFDTPSGRILSRASTDQTNVDLFPFFMAVTLAMYITLLSIIII  
TCQYAWPTIFLLIPLGWLNVWYRGYFIASSREITRLDSITKAPVIHHSSESISGVTTIRCFRQIGFTQENV  
HRVDKNLRMDFHNNGSNEWLGRLELIGSFIMCLSTMFMILLPSSIIKPENGLSLSYGLSLNSVLFWAIYM  
SCFVENKMSVERIKQFTNIPSEAAWQIKDRLPPPWPHTGNVELKDLQVRYRPNPVLKGITLNRGKEK  
IGVVGRTGSGKSTLVQVFFRLVEPSGGKIIIDGIDIGMLGLHDLRSRFGIIPQEPVLFEGTVRSNVDVPGQY  
SDEEIQSLEHCQLKEVVAGKPKLDSLVDNNGDNWSVGQRQLLCLGRVMLKRSRILFLDEATASVDSQTD  
VIQRIIREDFANCTIISIAHRIPTVMDCDRVLVIDAGRAKEFDKPSRLLERHSLFGALVQEYANRSAGM

>VvABCC5

MGIVLLLSFCVDDANLKFISSSSLTSSHTLLRAINGLPIELSSICINLTLFLVFLFIVSARQFFVCIGRV  
RIIKDDSGANSPIRRSIDREIRDIEIGKGFIAVSCCFYVLLLQVLVLDGIGLIRGALIGKTANWSLLC  
LPAAQFLAWFVLSVSAHCKFKVSEKFPLLLVRVWFVFSFIWLCVSVYVDAKGGFFREGLNHVSAHVLNFAAS  
PALAFLFFVAIRGVTGIQVRRNSDLQEPLPEEEAGCLKVTPYSEAGLFSVTLVSWLNPLL SVGAKRPLELK  
DIPLLAPKDRAKTNYKALNSNWEKKAENTSQKPSLAWAILKSFWREAACNAVFAGLNTLVSYVGPYIMISYF  
VDYLGNETFPHEGYILAGIFFSAKLVELTTRQWYLVGDILGMHVSALAMVYRKGLRLSSAKQSHTS  
EIVNYMAVDVQRVDYSWYLDIWMPLPLQIILALAILYKNVGIASVATFIATIIISIVTVPLAKLQEDYQDK  
LMAAKDDRMKRTSECLRNMRILKLHAWEDRYRMKLEEMRHVEFHWRKALYSQAFVTFIFWSSPIFVAAITF  
GTSILLGTQLTAGGVLALATFRILQEPLRNFPDLVSMMAQTKVSLDRISGFLQEEELQEDATIVLPRGITN  
MAIEIKNGEFCWDPTSSKLTLSGIQMKVERGRRVAVCGMVGSGKSSFLSCILGEIPKISGEVRIKCGSAAYVS  
QSAWIQSGNIEENILFGSPMDRAKYKKVLHACSLKDKLELFSHGDTIIGDRGINLSGGQKQRVQLARALYQ  
DADIYLLDDPFSAVDAHTGSELFKEYIMTALATKTVIFVTHQVEFLPAADMILVLKGGHIIQAGKYDDLQA  
GTDKFTLVSAHHEAIEAMDIPSHSSEDSDEIMPPNGSVLKCDDTQANNIENLAKEVQEGVSTSDQKAIKEK  
KAKRARKKQLVQEEERERGRVSMKIYLSYMAAAYKGLLIPLIILAQALFQVLQIASNWMMAWANPQTEGGLP  
KTSMPVLLGVFMALAFGSSCFIFVRAVLVATFGLEAAQKLVKMLRSVFRAPMSFFDSTPAGRILNRVSDQ  
SVVDLDIPFRLGGFASTTIQLLIGVGMVTKVTWQVLLLVIPIAIACLWMQKYMASSRELVRIVSIQKSPVI  
HLFGESIAGAATIRGFGQEKRFMKRNLYLLDCFRPFFYSLAAIEWLCLRMELLSTFVFAFCMILLVSFPHG  
SIDPSMAGLAVTYGLNLNARLSRWILSFCKLENKIISIERIHQYSQIPGEAPPPIIENSPPSSWPENGTIEL  
IDLKVRKESLPVVLHVSCTKFPGGNKIGIVGRTGSGKSTLIQALFRMIEPAGGKIIIDNIDISTIGLHDIR

SRLSII PQDPTLLEGTIRGNLDPLEEHS DQEIWQALDKSQLGDVIRQKEQKLDTPVLENGDNWSVGQRQLVS  
LGQALLKQARILVLDEATASVDTATDNLIQKIIRTEFQNTVCTIAHRIPTVIDSDLVLVLS DGRVAEFDTP  
ARLLEDKSSMFLKLVTEYSSRSSGIPDF

>VvABCC6

MAFGPLVWYCRPVTNGVWAKLVDNAFGVYTPCATDTLVISISHFILLSLCFYRIWRIKKDFKVQRFLRSNY  
YNYMLALLAGYCTAEPLFRLIMGISVFNLDGQAGLAPFEVSLI IKAFTWC SMLVLIGIETKVYIREFRWYL  
RFGVLYTLIGEAVMLNLILSVKELYDRSILYLYISEVVLQVLF GILLFFYVPDLPYPGYTPMWTGSVDDAE  
YEEIPGGEQICPERHVNI FSRITFGWMNPIMQLGSKRPITEKDVWKLDSWDQTETLNNNFQRCWAEALRPK  
PWLRLALNRS LGGRFWGGFWKIGNDLSQFVGPLILNQLLQSMQGDPAWIGYIYAFSIFVGVVFGVLFEAQ  
YFQNVMRVGFVRSTLVA AVFRKSLKLTHEGRRQFASGKITNLMTTDAEALQQICQSLHTLWSAPFRII IAM  
VLLYQQLGVASLLGALMLVLLFPIQTVVISRMQKLSKEGLQRTDKRIGLMNEILAAMDTV KCYAWENSFQSK  
VQSVRNEELS WFRKASFLGAFNVFMLNSIPVVIVISFGMFTLLGGDLTPARAFTSLSLFAVLRFP LFMPLN  
IITQAVNANVSLKRLEELFLAERILLPNPPELPLPAISIKNGYFSWDSKADRPTLSNVNLDIPVGG LVAI  
VGGTGEGKTSLSVAMLGELPPMSDASAVIRGTVA YVPQVSWIFNATVRGNILFGSPFEAARYEKAIDVTALQ  
HDLDLLPGGDLTEIGERGVNISGGQKQRVSMARAVYSNSDVYIFDDPLSALDAHVGRQVFDRCIKGELRGKT  
RVLVTNQLHFLSQVDRIILVHEGMVKEEGT FEELSNNGMMFQKLMENAGKMEEYVEENGA EENIDDKTSKPV  
ANGVVDKLPNNSSNTSKPKEGKSVLIKQEERETGVVSWKVLVRYKNALGGLWVVMILFMCYIILTETLRVSSS  
TWLSQWTDQGGSRTHGPGYYNLIYAMLSFGQVLVTLANSYWLIMSSLYAAKRLHDAMLG SILRAPMLFFHTN  
PIGRIINRFAKDLGIDRNVAVFVNMFLGQISQLLSTFVLIGIVSTMSLWAIMPLLVLFYSAYLYYQNTARE  
VKRLDSITRSPVYAQFGEALNGLSTIRAYKAYDRMADINQSM DNNIRYTLVNMSNRWLAI RLEALGGLMI  
WLTATFAVMQNERAENQAFAS TMGLLSYALNITSLLTGVLRLASLAENSLNSVERVGSYIELPSEAPLVI  
ESNRPPPAPWSSGSIKFEDVVLRYRPELPPVLHGLSFTISP SDKVGIVGRTGAGKSSMLNALFRIVELERGR  
ILIDDCDISKFGRLDRKVLGIIPQSPVLFSGTVRFNLDPFNEHNDADLWEALERAHLKDVIRRN SGLDAE  
VSEAGENFSVGQRQLLSLARALLRRSKILVLDEATAAVDVRTDALIQKTIREEFKCTMLIIAHLRNTI IDC  
DRVLLLDAGRVLEYDTP EELLSNDRSAFSKMQSTGAANA EYLRSLVLGGEGENKLGREDNRRLDGQRRLWA  
SSRWATAAQFALAVSLTSSQNDLQLEIEDENSILKKT KDAVITLQGVLEGGHDKVIEETLNQYQVSRDGMW  
SSLYRMIEGLAVMSRLARNRLQSENGFEDRSIDWDRIEM

>VvABCC7

MAFEPLVWYQCPVANGVWAKAAESAFGPYTPCAVDSIVVCISHLVLLGLCCYRIWL IKMDFKVQRFLQSNY  
YNYMLGLLACYCTAEPLFRLVMGVSIFDLDEQTGLAPYEIVSLIIEAATWC SMLVMIGVETKIYIRQFRWYV  
RFGVIYLLVGDAVMLNLILSLKDSYSRSVLYPPISSVLCQVLF GICLLVHVPNLNPNYVGYTPMQSDSLENTK  
YEVLPGGDQICPEKHANMFSRIYFGWMTPLMQQGYK KPI TEKDIWKLDTWDQTETLSRRFQKCWIEESQRSK  
PRLRLALNCS LGGRFWRGGFFKIGNDLSQFVG PVLNHLQLSMQRGDPAWIGYIYAFSIFIGVSLGVLCEAQ  
YFQNVMRVGFRLRSTLVA AIFRKSRLTHEGRKNFPSGKITNMMTTDANALQQICQLHALWSAPFRII IAM  
VLLYQQLGVASLLGSLMLLLMLPIQTFIISKMRKLSKEGLQRTDKRVSLMNEILAAMDTV KCYAWEKSFQSK  
VQSMRNDELS WFRKAQLLSACNSFILNSIPVIVTVTSFGAFTLLGGDLTPARAFTSLSLFAVLRFP LNMLPN  
LITQVVTAHVSIQRLEQLF LTEERVLAPNPTLEPGLPAISIKDGYFSWDSKVEKPTLSNINLDIPVGS LVAV  
VGGTGEGKTSLSISAMLGELPPLSDASV VIRGTVA YVPQISWIFNATVRGNILFGSDFEPARYWKAIDVTELQ  
HDLDLLPGHDLTEIGERGVNISGGQKQRVSMARAVYSNSDVYIFDDPLSALDAHVAQQVFSNCKEELKGKT  
RVLVTNQLHFLPHVDRIILVSDGTVKEDGTFDDL SKNSKLFQKLMENAGKMEEQVEENE CRENLNNKSKPT  
TNGEVNELPKNAIHSNKGKEGKSVLIKQEERETGIVSWKVL MRYKDALGGLWVVTLLFACYVLTEVLRV LSS  
TWLSVWTDQSM SKDYRPGYYNLIYALLSFGQVMVTLGN SFWLITSSLHAAKILHNVM LNSILRAPMVFFHTN  
PIGRIINRFAKDLGIDRNVAPSANMFLGQVWQLLSTFVLIAIVSTISLWAIMPLLILFYAAYLYYQST SRE  
VKRLDSITRSPVYAQFGEALNGLSTIRAYKAYDRMASINGKSM DNNIRFTLANISSNRWLTIRLET LGGMLI  
CLTATFAVMENSREENPA AFASTMGLLSYTLNITSLLSGVL RQASRAENSFNAVERVGT YVDLPSEAPTII  
ESNRPPPGWPSSG SIRFEDVVLRYRPELPPVLHG ISFKISPSEKLGIVGRTGAGKSSMINALFRIVELERGR  
IWIDEYDIAKFGLTDLRKVLSIIPQSPVLFSGTVRFNLDPFNEHNDADLWEALERAHLKDVIRRN SFG LDAE  
VAEGGENFSVGQRQLLSLARALLRRSKILVLDEATAAVDVRTDALIQKTIREEFKCTMLVIAHLRNTI IDC  
DRILVLDAGQVVEYDTP EELLQDEGSSFSRMVRSTGAANA QYLRSLVFGEDGQKKS GREEAKQLDRQKRWLA  
SSRWAAATQFALSISLTSSQNGLQFLDVEDEMNILKKTND AVLTLRGVLEGGHDEVI EEMLKEYQVPRDRWW  
SALYKMEGLAVMNRLARHRFQQSEHDFEDTTLDWDLTEM

>VvABCC8

MAFGPLVWYCRPVEHG VWAKAEGSAFGAYTPCGVCTLVVCISHLVLLALCSCRLWL IKMDFMVQRFLRSNY  
YNYMLGFLAFCCTAEP LRLIMGVSVFNLDGQTEMAPFELVSLMIEALAWFLMLVMISVETKIYIQELRWYV  
RFGVIYLVVGDVVM LGHILSMKDIYSRSVLF LQISSVFFQAF LGISLLVYLPNLNTYVDNTLMQTEPLVNTK

YEELPGGEQICPERHANMFSRIFFGWAPLMQQGYRKLPTKEDVXKLDTDWQTETLNRRFQACWVEESQRSK  
PSLLRALNHALGGRFWLGGFYKIGEDLCEFGPIILLSYLLQSLQQGPAWIGCIYAFSIFLGVSLGLLCEAQ  
YYQNVIRVGFRLRSTLVATIFRKSRLNHEGCKNFSFGKITNMVTTDANALQEICKALHDLWSAPFLIISM  
VLLYQQLGAASSLGSIILLMLPIQTFVISKMKKLSKEGLQRTDKRVSLMNEILAAMDAVKCYAWEKSFQSR  
VQSMRTDELSWFHKAQMLSACNTFILNSIPIIVTVTSFGSFTLLGGDLTPARAFTSLSLFAMLRYPYMLPT  
LITQVVTANVSVQRVEELLTEERILVNPFFEPGLPAISIKDGYFSWEKAKKPTLSNINLDIPVGSVAVV  
GRTGEGKTSLISAMLGELPPAADASVIRGAVAYVPEVSWIFNATVRENILFGSNFEPARYWKAIAVTALQH  
DLDLLPGHDLTEIGERGVNISGGQKQRVSMARAVYSKSDIYIFDDPLSALDAHVAQQVFRDCKEELRGKTR  
VLVTNQLHFLPEVDRIILVSEGVMKQDGTDEL SKNSMLFQKLMENAGKMDKRMEKECSKNLSHNKSKPTA  
NYAVDKLSKNASYFNEKKEGKSVLIKQEERETGVVSWNVLMRYKDALGGLWVVVLFACYVLTEVLRIGSST  
WLSFWDQSTLDDYRPGYNYLIFALLSFGQVTATLANSFWLISSLYAAKRLHDAMLNSILRSPMVFHTNP  
IGRIINRFKDMGDIRNIANYVNLFLGRLWQLLSTFVLIGIVSTVSLWAIMPLLLIFTYVLYYQSTSREA  
KRLDAITRSPVYAQFAEAFNGLSTIRAYKAYDQMANINGISMDNNIRFSLIISSTDGWLAIRESAILGGLIIV  
LTASFAMENVRTENQAFASTMGLLLSYALNIKNLGSLVRNASAAENSLNAIERVCTYVDLPSEAPAPIE  
NNRPPPGWPSSGSIKQDIVLRYRPELPPVLHGLSFKISPSEKLGIAGRGTGAGKSSMINALFQIVELESGRI  
LIDEYDISKFGLTDLRKVLSIIPQSPILFSGTVRFNLPFNEHNDADLWKALKRAHLKDFIRMNSFGLDAEV  
LARGENFSVGQRQLLSLARALLRRSKILILDEATAAVDVKTDALIQKTIREEFKCTMLIIAHLNTIIDCD  
RILVLDGQVLEYDTPPELLNEGSSFSKVMKSTGAANAELRRLVLGEEGEEAMQLDRQPRLLASLR

>VvABCC9

MPDFKQEFQTAWLQLSSPCLWEDVSIVLQLGFLGIFLLHLVQKIVGHLWKHRTTVTDKGIEMYPNEAKASFS  
CKASIICSSILLGIHVIVLLMPPNGSEGCKSPILVLSSEVMQVMIWLITLIAVCKISTKKYVKFPWILRTY  
WLCFLLSVIHTAFDVHFLVTNNGHLRMQDYTDLFLGLLASTCLFGISIRGKTGTVLISQNLADPLLNKTD  
NHSEKTESPYGKATLFLQITFSWLNPLFAVGIKKPLAQDEIPDVKDSAEFTSHYFDECLKHVRERDGT  
NPSIYKAIFLFIWKAANALFAMISAAASYVGPYLIDDFVNFSLMKKTRSLESGYLLALAFLSAKTVETIA  
QRQWIFGARQLGLRLRAALISHIYKGLVLSQSRSQHTSGEIIINYMGVDIQRMTDFIWMNTIWMPLIQIS  
LAICVLMNMIIGLSLAALATLMVMACNIPLTRIQRYQSKIMEAKDERMKATSEVLRNIKTLKQLQAWDSQF  
LHKLESRLKIEYNWLVKSLRGLSALFIFWGSPTFISVTFGACLIMGIELTSGRVLSAKATFRMLQDPIFN  
LPDLLSVIAQGVSVDRVASFLQEDEVQSDTIEFVPKDQTEFEVEIDNGKFSWNPDSSSPTLDKIQLKVKRG  
MKVAICGTVGSGKSSLLSCILGEIKKLSGTVKIGGKAYVQSPWILTGNVKENILFGNRYDSVKYDETVKA  
CALTKDFELFPCGDLTEIGERGINMSGGQKRIQIARAVYEDADIYLLDDPFSAVDAHTGTQLFKDCLMGIL  
KNKTILYVTHQVEFLPAADFILVMQDGRIAQAGRFELKQNIQIGFEVLVGAHNQALESILTVENSSRTSKDP  
VPENESNKDPTSNSEMIHTQHDSEHNISLEITEKQGRLTQDEEREKGSIGKEVYMSYLTIVRGGALVPIIIL  
AQSMFQVLQVASNYWMAWASPPTSESRPKMGLDYILFVYILLAVGSSLFVLLRASLVAITGLSTAQKLFVKM  
LQSVVRAPMAFFDSTPTGRILNRASIDQSVLDMEMANRLGWCAFVSIQILGTIAVMSQVAWEQYYIPTAREL  
GRLASIQQSPILHFFSESLGAATIRAFDQEDRFIHANLDLVDNFSRPWFHNVSAMEWLSFRNLVLSNFVFA  
FSLVLLVSLPEGIINPSIAGLAVTYGINLNLVQASVIWNICNAENKMISVERILQYSKIKSEAPLVIEECP  
ENNWPQVGTICFQNLQIRYAEHLPSVLKNISCTFPGGMKIGVVGRTGSGKSTLIQAIFRIVEPREGSIIDG  
VDISKIGLHDLRSRLSIIPQDPAMFEGTVRGNLPLDQHPDGQVWEALDKCQLGDLVRAKEEKLDSSVVENG  
ENWSVGQRQLVCLGRALLKRSSILVLDEATASVDSATDGVIQKIISQEFKDRTVVTIAHRIHTVIDSDLVLV  
LSEGRIAEYDTPAKLLERDDSSFFSKLIKEYSKRSKGFGLAIST

>VvABCC10

MENEKLVNAVVIILRYLNEAPRKELLSKTYNLEVEANMDTLTGQLKGTQSYWHLLTFKAITSVMNHGVK  
QLDFEDLLQLPIDMDPSSCHATLLSCWHAQQRHNCNSPSLFRAICCAYGWPYFRLGLLKVVNDICIGFVGPV  
LNNLIRFLQQGSGNLDGYILAVAMGLIPIFKSFLDTQYTFHLSKLLKLRSSIMTVIYHKCLCVNLAERSKF  
SEGEIQTFFMSVDADRIVNLCNSFHDMWLSPLQIGLALYLLYTQVKFAFVSGIAITILLIPVKNWISKFIARA  
TEKMMKKKDERISKTAELAYIRTLKMYGWELLFMSWLMERSSEVKHLSTRKYLDAWCVFFWATPTLFLSL  
FTFGLFTLMGYQLDAAMVFTCLALFNTLISPLNSFPWINGLIDAIISTRRLSRFLSCSEHKPAELEQTAGS  
PSSPSFSGQFNFKLEDMAVAMYDASCAWSSSEVEKDLVHHVTLGLPRGSLVAIIGEVGSGKSSLLNSILK  
EMRLIHGSIYSDGSITYVPQVPWILSGTIRENILFGKAYDPTRYSDVLEACALDIDISLMVGGDMAYIGDKG  
VNLGGQRARLALARAIYHGSDFMLDDVLSAVDTQVARCILHNAIILGPLMNQHTRVLCTHNIQAMSSADMI  
VMDKGVHVKWVGSSTDFSVSSYSTFCSLNEFTVSQVRSLECASTNTSTETKQDCKPERDSICVPGEAQEIEV  
ELRKEGRVELTVYKSYATYSGWFITVVICLSAILMQASRNGNDLWLSYWVDTTGGSSHTEYSTSFYLVLCI  
FCVINSFLTIVRAFSFAFGGLRAAVQVHNTLLSKLINAPVHFFDKTPGGRIILNRMSSDLYTIDDSLPIFILNI  
LLANIVGLLGAIVLSYVQVFLLLLLLPPFWYVYSKIQFYRSTSRRLRRLDSVSRSPIFASFTETLDGSSTI  
RAFKCEDLFFTRFSEHVALYQTSYSELIASLWLSRLQLLAALVISFVAMMAVIGSRDSLPIISLGTPLVGLV  
LALSAAPIVSLGSLTSTFTEKEMVSVRVLQYMDIPQEELNGCQSLSPNWPSEGYIMFQNVSLRYLPS

LPDALHDITFTISGGTQVGIIGRTGAGKSSILNALFRLTPICKGCILVDGLDIADVPVRDLRSHFAVVPQSP  
FLFEGSLRDNLDPRVSDDLKIWKTLERCHVKEEVEVAGGLDIHVKESGTSFSVGRQLLCLARALLKSSKV  
LCLDECTANIDAQTSSVLQNAILTECRGMTVITIAHRISTVLSMDNILILDRGILVEQGNPQVLLQDHSSRF  
SGFAKASTM

>VvABCC11

MASLEISLGGFSWVCGEELDLGSFCIQRTILDVNLFLSVFVILVIGYIRKHEISGCSRRDWSGGVSIC  
CALGTGIAYVSAGFDLVRNGGSQPLGWL VYFVRGLTWISLAVSLLVRSSKWSRILSFLWWL TFFSLVSTLN  
IEILVKTHNIKIFDIVPWL VNSLLIFCAFRNIFHSVSEDTPDKSESEPLLAKKPVRRTVEVGKISFITKLT  
SWINPILCLGNSKPLVLEDVPPLEASEDEAEAYQKFSQAWECQRRERSSSSTDNLVFRALAIIVYLKEMIFVG  
LCALLRTISVVVSPLLL YAFVKYSTRDEENWQEGVFLMGCLIIISKVSVSQRHWF LNARRFGMRMRSALMV  
AVYQKQLKLSLGRRRHSSGQIVNYIAVDAYTTGEFPWWFHSASWYILQLF LFSIGVLFVVGVLGALSGLAPL  
LVCGLLNVPFAKILKQCQSQLMMARDQRLRSTSEILNSMKVIKLSWEDKFKNFIESLRDVEFKWLAEAYK  
KCYNTVLYWMSPTIVSSVTF LGCALFGSAPLNASTIFTIVAALRCMGEPVRMIPEAISVMIQAKISFERLNA  
FFLDDELKSEEMRRVTL PNSDHSVINGGNFSWEPESAVL TLRDINLGVKRGQILAVCGPVGAGKSSFLFAI  
LGEIPKISGSDVFGSIAYVSQTSWIQSGTIRDNILCGKPMDDTKYEKAIKACALDKDINSFDHGDETEIGQ  
RGLNMSGGQKQRIQLARALYNDAEIIYLLDDPFSAVDAHTAAILFNDCVMAALRHKTVM LVTHQVEFLSQVEK  
ILVLEGGRITQSGSYEELL TTGTAFEQLVNAHKNAITVLDL SNNEGEETQKLDHILPEVSHGSCPTKERSEG  
EISMKGLRGGQLTEEEGMEIGDVGWKAFWDYLLVSKGALLMFGSMIAQCGFVALQAASTYWLALGIEIPKIS  
NGMLIGVYAGISTLSAVFVYLR SFLIARLGLKASKAFFAGFTSSIFNAPMHFFDSTPVGRILTRASSDLTVL  
DSNIPFSIIFVLSAGIDILTTIGIMASVTWPVLVIAIFAMVAAKYVQGYLASARELIRINGTTKAPVMNYA  
AESSLGVTIRAFNMVDRFFQNYLKLIDTDAKLFY SNAAMEWLVLRIEALQNL TLVTAALLVLLPKGYVA  
PGLVGLSLSYALALTGTQVMLSRWYCNLSNYMVSVERIKQFMHIPSEPPAIVDVKRPPSSWPSKGRIELQNL  
KIKYRPN SPLVLKGITCIFKEGTRVGVGRTGSGKTT LISALFRLVEPESGTLVDGLDICSIGLKDLRMKL  
SIIPQEPTLFKGSIRTNLDP LGLYSENEIWKALEKQKATISSLPNLLDSSVSDEGENWSAGQRQLFCLGR  
VLLKRNRI LVLDEATASIDSATDAILQRIIRQEF SNCTVITVAHRVPTVMDSDMMVLSYGLKVEYDKPSNL  
MDTNSFSKLVGEYWSSRRNS

>VvABCC12

MAFLKNSFSGLSWMCGEELDMGSFCIQRSILDVNLFLSVFCVLLVIGSIRKHEISRCSRRDWSRGVSIC  
CALISIGYLSAGFDLYAKNEGPR LSSWPVYFVRGLIWI SLTVSLLVQRSKWTRILSSIWMSFFLLVSALN  
IEIIVETHSIQIFVMVPWL VNFLLLFCAFRNICPSLSLEASDKSVSEPLLAKNPVKSSIDFSKSSFISKLTF  
SWINPLRLRGYSKPLVLEDIPSLTPEDEAEAYKNFAHAWELLQREKNSTNTSNLVLRALAKVYWKETVFVA  
ICALLRTISVVVSPLLL YAFVNYSNRKEENLSEGLFLVGCLVIAKVVESVSQRHWF LDRRSRGMRSALMV  
AVYQKQLKLSLGRRRHSAGEIVNYIVDAYRMAEFLWVWFHSMWSYMLQLF LFSIGVLFVVVGLGALSGLVPL  
FICGFLNVPFAKILKTCQTELMMAQDRRLRSTSEILNSMKVIKLSWEDKFKNLI ESREVVEFKWLAEAYK  
KCYNTVLYWLSPTIISSVIFVGCALLGAPLNASTIFTILAALRCMGEPVRMIPEALSALI QVKVSFDRLNAF  
LLDDELKSEEIRHVTWPNSGHSVKINAGKFSWEPESAILTLREVNLTVQRGHKIAICGPVGAGKSSLLHAIL  
GEIPKISGTVDFVFSIAYVSQTSWIQSGTIRDNILYGKPMDDTKYEKAIKACALDKDINSFDHGDETEIGHR  
GLNMSGGQKQRMQLARAVYNDADIYLLDDPFSAVDAHTAAILFNECVMAALAHKTVILVTHQVEFLSEVDKI  
LVMEAGQITQSGSYEELLTSGTAFEQLVNAHKNAVTVLEFSNDEQVEPQKLDQNLLEKSHGSLFTKENSEGE  
ISMKGLPGVQLTEEEETEIGDVGWKPF LDYLLVSNGLMLMSLGIITQSGFIALQAASTYWLALGIRIPNISN  
TL LIGVYTAISTLSAVFVYFRSFCARLGLKASKAFFAGFTNSIFNAPMLFFDSTPVGRILTRASSDFSVVD  
FDIPFSIIFVVAAGLELIT TIGIMASVTWQVLFVAIFAMVTANYVQGYLASARELIRINGTTKAPVMNYAA  
ETSLGVVTIRAFKMVDRFFQNYLELIDTDAKLFY SNAAEIWLVLRIEMLQNL TLVTAALLVLLPKGVVVP  
GLVGLSLSYALALTGSQVFLSRWYCNLSNYIVSVERIKQFMRIPEPPAIVEGKRPSSWPSKGRIELQNLK  
IKYRPNAPLVLKGITCTFKEGTRVGVGRTGSGKTT LISALFRLVEPESGKILIDGLDICSIGLKDLRMKLS  
IIPQEATLFKGSIRTNLDP LGLYSDNEIWEALEKQKATISSLPNLLDSSVSDEGENWSAGQRQLFCLGRV  
LLKRNRI LVLDEATASIDAATDAILQRIIRQEF LNCTVITVAHRVPTVIDSDMMVLSYGLKVEYDEPSNLM  
ETNSFFSKLVAEYWSSRRRNSSQNFNYK

>VvABCC13

MASWDSSLGGFSWNSGEGLDMGFFCVQTTILDVNLFLSVFCVILVMGSRKNVIFEHSRRDWSGGVSIC  
CAVVSIGYLSAGLWDLFVKNEGSGHL SWWAYFVRGLVWISLAASLLIQRPKCIRILSSLWWLAFLLGSALN  
IEILVKTHNIQVFDMPWL VSFLLLFCAFRNICHHSDPDPDRSVSEPLL GKKPEKSSVELGKSSFISKLTF  
SWINPLLCLGYSKPLVLEDIPSLVSEDGAELAYQKFAHAWELQKEKTPNNSCNLVLQALARVYWKETLSAG  
IFALFKTISVVVSPLLL YAFVKYSNHSGENWHEGVFLVGCLVLNKLVESLSQRHWF LNSRRSGMRMRSALMV  
AVYQKQLKLSLGRGRHSTGEIVNYIAIDAYRMGEFPWWFHTMWSFILQLF LFSIGVLFVIGVGLGALTGLVPL

LICGLLNVPFAKIIQRCQFQFMMAQDQRLRSTSEILNSMKVIKLSWEEKFKNLIESLRDIEFKWLAEAHYK  
KCYCTVLYWLSPSIIPSVIFLGCVVFRSAPLDASTIFTVLAALRCMSEPVRTIPEALSALIQIKVSFDRLNA  
FLLDDEVKSEEIRKVVVPSHYSVIVNGCGFSWDPKSTILTRDVMMEVKWGQKVAVCGPVGAGKSSLLYAI  
LGEIPKVSQVDFVGSIAVVSQTSWIQSGTIRDNILEYGRPMKTKYEKAIKACALDKDINSFDHGDLEIGQ  
RGLNMSGGQKQRIQLARAVYNDANIYLLDDPFSAVDAHTAAVLFNDCIMSALAQKTIVLVTHQVEFLSAVDK  
ILVMEGGQITQSGSYEELFAAGTAFEQLVNAHKNATTVMNLSNKEIQEHPKLDQSPTKESGEGEISMKGLQ  
GVQLTEEEEREIGDVGWKPFLDYLLVSKGSFLLFLCIIITKSGFIALQAASTYWLALAIEMPKISNGMLIGVY  
AGLSTLSTGFIYLRFFGARLGLKASKAFFAGFTNSIFKAPMLFFDSTPVGRILTRASSDLSVLDLDFIPFSI  
IFVVASGLELLSIIIGVTASITWPVLIVAFIVAVVYVQGYLASARELIRINGTTKAPVMSYAAETS LGVV  
TIRAFNMVDRFFQNYLELIETDAKLLFFYSNAAIEWLVLRIEILQNLTLVTAALLLVLLPKGYVAPGLVGLSL  
SYALALTGTQVFFSRWYCNLSNYVVSVERIKQFMHIPSEPPAIVEEKRPPTSWPSKGRIDLQYLKIKYRPNA  
PLVLKGITCTFKEGTRVIVGRTGSGKTTLISALFRLVEPESGKIFIDGLDICSIGLKDRLMKLSIIPQEPT  
LFKGSIRTNLDPLGLYSDDIWEALEKCQLKATISSLPNLLDSYVSDEGENWSAGQRQLFCLGRVLLKRNRRI  
LVLDEATASIDSATDAILQRIIRQEFNSCTVITVAHRVPTLIDSDMVMVLSYGKLVVEYDEPSNLMETNSSFS  
KLVAEYWSSCWNRSSQSFNYYKQRS

>VvABCC14

MGEDLWDVFCGNSGCSRKVGKICSSGFLAIICPCSCINHI FVISVDILLFFIVLLIFTYKASATKLLPSQKS  
RCSTKMPNSAAIFNGGLGLVYLGFQFWMVAEKPSNEDIVLPLYRCLMVL SQGFTWSLLGVAVWFKRHQLAEI  
TLMRLCSIFAFFAGFLCLQSLWEPIVENAELVKIVLDILSFPGAILLLFCTFWTPEYAETKGDNTGAAYT  
PLSCEEACGGSKINSEDLNTPFAKAGFLSRMSFWWLNLSLLKKGKKTLED RDVPLLRREDRAETCYSMFLEQ  
QNKQKQKESDPPSMLTTIFFCYWKEIFITGLFALIKVLALATGPLFVRAFIMVAEGKEAFKYEGYALTGGL  
FLTCKLESLLERQWFFRTRLIGLQVRSLLSAAIYQKQLRLSNTAKASHSSGEMNYVTVDTYRIGEPFYWLH  
QVWSTSLQMCILIVYYSVGLATVPLLAILLTVLVNSPLGKLQKYQIKLMAAQDRKKAFTESLINMKI  
LKLAWETHFKNVIEGLRKEESQWLSAVLMKRAQKLVLFWSCPVLGSAATFWACYFLGIPLTASSAFTFLAS  
LRIVQEPIRLIPVVSFAIEAKVSLTRIVKFLAPEVDGRHVKKMFDGKEEESIFIKADRI SWDNNSTRAT  
LRNINLVKHGKVAICGEVSGKSTLLAVILGEVPHVDGKQVYQYGMAYVSQAAWIQTGTIENILFGSAM  
DPYRYVVEIKESLVDKLEMLPFGDLTEIGERGVNLSGGQKQVQLARALYQDADVYLLDDPFSAVDAHTAA  
SLFNEYVMGALSSKTVILVTHQVDFLPAFDSVLLMSEGEILQAATYDQLMHSSQEFWDLVEAHKGTAGSERQ  
QDHASSQKPNTSKREIQTITKEEFGETSGDQLIKKEERETGDTGFKPYIQYLLKQSKGFLYFSLSTMFHLIF  
TVGQLIQSYWLAADIQNPSSVSKPKLLTVYTVIGFSMIIFFRSIFIVVLGLRASESIFSTLLSSLFQAPMF  
FYDSTPLGRILSRVSSDLSVVDLDAFKLTFAVGAAVTTYSSFGVVAIFAWQLLFVIVPTIYLTTLIQSYF  
ASAKELMRISGTTKSLVASHLAESVAGAMTIRAFREEDRLF SKNLDLIDTNASPLFHNFTANEWYIQRLEII  
SAIALSSAALATLLPEGASKSGFVGMALSYGLSLNVFLVFTVQNQC SLANMIISVERLEQYMHIPSEAPEV  
IEYNRPPPNWPAIGVEICDLKVRYPNSPLVLQGISCKFEGGQKIGIVGRTGSGKTTLISTLFRVLEPTEG  
HIIIDGLNISTIGLYDLRSRLGIIPQEPTLFGSVRYNLDPLSRHTDHEIWEVLGKCQLRGAVEEKDEGLDS  
LVVQDGSNWSMGQRQLFCLARALLKKSRI LVLDEATASIDNATDSILQKTIRTEFADCTVITVAHRIPTVMD  
CTMVLITISDGKLVVEYDEVSKLINKEGSLFGQLVHEYWSRASNFTACGD

>VvABCC15

MGESLWIVFCGNSVCLSKIGKICSSRFLAIICPCSCNLNHLVISIDIIILLFFLLFIFIYKASAMKILFPQQS  
LCFSTMLNSAAFLNGSLGLVHLGLGIWILREKLSEENTILPLHGWLAILLQGFTWFFLGLAVRFRRHQLLHI  
AGLRLCSVLAFFIAGFLCVTSIWEAIVGDAVSVKMILDVISFPGAILMLSTFSGPKYAGTDSEIDGAGFYT  
PLPGEVGGSGGDKINSASLPPFEKAGLISRLSFWWLNLSLMKKGKEKTLEDKDIPQLRKEDRAEMCYLMFMEQ  
QNKQKKNRSDSPSILSTICLWQWKQILISGIFALIKVLTSTGPLFLRAFILVAEGKEAFKYEGYALTGGL  
FLTCKLESLSERQWFFRTRLIGLQVRSFLSAAIYQKQLKLSNAAKGSYSPGQIINFVTIDAYKIGEYPYWFH  
QIWSTSLQLCLGLATIAALFVVILTIVIANSPMGKQLQHKYQKTLMGTDKRLKAFTEALTNMKILKLYAWETH  
FKNVIEGLRKEEFKWLSSVLSQRGYSLLWWSFPIVVSVAFWACYFLGTTLSATNVFTFMASLRIAQEPIR  
LIPDVISAFIEAKVSLDRIAKFLDAPELQNKHVRRMCDGKEEESIFIKSNRISWEDNSTRATLRNINLVK  
PGEKVAICGEVSGKSTLLAAILGEVPHVNGIVRVYKIAVVSQTAWIPTGTIRENIFGSAMD PYRYREAI  
EKCALVKDLEMLPFGDLTEIGERGVNLSGGQKQVQLARALYQDADVYLLDDPFSAVDAHTATSLFNEYVMG  
ALSTKTIVLVTHQVDLLPAFDSVLLMSEGEILEAATYDQLMHSSQEFQDLVNAHNATV GSEMPEHDSTQKS  
KIPKGEIQEICTEKQLRDTSGEQLIKKEERETGDTGLKPYLQYLYCKGFLYFFLATLSHVIFIVGQLVQNY  
WLAANVQNSSVSQLKLIAYVTGIGLSLSLFLLLRSFFVLLGLGASQSIFSTLLSSLFRAPMSFYDSTPLGRI  
LSRVSSDLSVVDLDAFKFTFSVGAAMNTYASFGALAILAWELVLVILPTIYLSILIQRYFYAAGKELMRIN  
GTTKSFVASHLSESIAGAMTIRAFGEDRHF SKNLGFIIDINASPFFYSFTANEWL IQRLEILCAIVLSSAL  
ALLTLLHTSAAKAGFIMGALSYGLSVNAFLVFSVQSQC LLANMIVSVERLEQFLNIPSEAPDVME SNQPPLSW  
PAIGVEIYDLKVKYRPNAPLVLQGISCKFGGQKIGIVGRTGSGKTTLISTLFRVLEPTEGRIIIDGINIS

TIGVHDLRSRLGIIPQEPTLFSGSVRYNLDPLSLHTDEEIWEVLEKQCQLRGAVQEKEEGLDSL VVQDGSNWS  
MGQRQLFCLGRALLKRSRILVLDEATASIDNATDSILQKTI RTEFADCTVITVAHRIPTVMDC TMVLAISDG  
KLVEYDEPMKLIKESLFGQLVKEYWSRSSNGRNTSEDWL

>VvABCC16

MGESLWTVFCGSTGCSSKIGKISSGFLAIICPCSCNLNHLVISVDIILLFLLLFIFIYKASALKILSPQRS  
LCFSTTLNSAAFLNGSLGFVYLG LGIWI LGEKLI EENTILPLHGWL VNL LQGFAWFFLGLAVRFRRHQVLHI  
AGLKLCSVLAFFIAGFLCVTSFWEAIVSDAVSVKMILDVISFPGAILSMFSTFSGPKYAGTDSEIDGAGFYT  
PLPGE GSGGDKINSDASLPPFQKAGLISRLSFWWLNLSIKKGK EKTLEDKDIPQLRREDRAEMCYSMFMEQ  
QNKQKNKRSSHSPSILSTILLWQWKQILFSGFYALIKVLTSTGPLFLRAFILVAEGKEAFEYEGYALTGGL  
FLT KCLESLSERQWFFRTRLIGLQVRSFLSAAIYQKQLKLSNAAKGSPGQIINFVTIDAYKIGEYPYWFH  
QIWSTSLQLCLALLIIYYSVGLATIAALS VVILTVVTNSPMGKLQHKYQKMLMGTQDKRLKTFTEALTNMKI  
LKLYAWETHFKNVIEGLRKEEFKWLSSVLSQRGYNLILFWSSPIVVS AVTFWACYFLGTTLSATNVFTFMAS  
LRLAQEPIRLIPDVISAFIEAKVSLDRIAKFLDAPELQNKHVRKMGD GKELEESIFIKSNRISWEDNTTRAT  
LRNITLVVKPGEKVAICGEVGS GKSTLLA AVLGEVPHVNGIVRVYKIAVVSQTAWIPTGTIQENILFGSAM  
DPYRYREVIEKCALVKDLEMLPFGDLTEIGERGVNLSGGQKQRVQLARALYQDADVLLDDPFSAVDAHTAT  
SLFNEYVMGALSTKTVILVTHQVDFLP AFDSVLLMSEGEILQAATFEQLMRFSQEFQDLVNAHNATVGSERQ  
PEQDSTQKSKIPKEIQKIYTEKQLRDTSGEQLIKKEEREIGDTGLKPYLQYLKYSKGFLYFFLATLSHVIF  
IVGQLVQNYWLAANVQNSSVSQKLI AVYTGIGLSLSLFLLLRSFFVLLGLEASQSIFSTLLSSLFRAPMS  
FYDSTPLGRILSRVSSDLSVVDLDAFKFTFAVGAAMNAYASFGVLA I LAWELVFVILPTIYLSILIQRYYF  
AAGKELMRINGTTKSFVASHLSESIAGAMTIRAFGDEDRHFSKNLGFIDINASPFFYSFTANEWLIQRLEIL  
CAIVLSSSALALTLIHTRASKAGFIGMALS YGLSVNIFLVFSVQSQC LLANMIVSVERLEQFMNIPSEAPAV  
IESYQPPLSWPAIGEVEIYDLKVKYRPNAPLVLQGISCKIGGGQKIGIVGRTGSGKTTLISTLFRLEVEPTG  
QIIIDGINISTIGLHDLRSRLGIIPQEPTLFSGAVRYNLDPLSLHTDEEIWEVLEKQCQLRGAVQEKEEGLDS  
LVVQDGSNWSMGQRQLFCLGRALLRRSRILVLDEATASIDNATDSILQKTI RTEFADCTVITVAHRIPTVMDC  
TMVLAISDGKLVEYDEPMKLIKESLFGQLVKEYWSRSSNGGNTSEDWL

>VvABCC17

MLNYAAFLNGSLGLVYLG LGFWIVGEKLI EENTILHLHGWL MVLLQGF TWFFLGLAVRFRKHQLPHIAGLRL  
CSVLAFFIAGFHCVT SFWEAIVGDAVSFKMILDVMSFPGAILLMFCTFSGPKYAGADSEIDGAAFYAPLPGE  
GGSGGDKINSDASLPPFEKAGLISRLSFWWLNLSMKKGK EKTLEDKDIPQLRREDRAEMCYLMFIEQQNKQK  
KKQSLDSPSILSTILLWQWKQILISGFFALMKVLTLSIGPLFLRAFILVAEGKEAFKYEGFALTGGLFLT KC  
LESLSERQWFFRTRLIGLQVRSFLSAAIYQKQLKLSNPAKGLYSPAQIVSFVTIDAYKIGEYPYWFHQIWST  
SLQLCLALLIIYYSVGLATIAALFV VILTVVN SPVGR LQHKYQKMLMGTQDKRLKAFTEALTNMKILKLYA  
WETHFKNVIERLRKEEFKWL SVLSQKGYIVILFWSSPIVVS AVTYWACYFLGTTLSASNVTFFMASLSIAQ  
ESIRLIPDVISAFIEAKISLDRIAKFLDAPELQNKHVRKMGD GQLEESIFIKSNRISWEDNSTRATLRNIN  
LVVKPGEKVAICGEVGS GKSTLLA ALLGEVPHVDGIVRVYKIAVVSQTAWIPTGTIQENILFGSAMDPYRY  
REAIEKCALVKDLEMLPFGDLTEIGERGVNLSGGQKQRVQLARALYQDADVLLDDPFSAVDAHTATNLFNE  
YVMGALSMKTVILVTHQVDFLP AFDLVLLMSEGEILQAATYDQLMHSSQEFQDLVNAHNAMVGSERQPEHDS  
TQKSKIRKGEIQKIYTEKQLRETSGEQLIKKEEREMGDTGLKPYLQYLEYSKGFLYFFLSTLSHVIFVVGQL  
VQNYWLAANVQNFVSQKLI AVYTGIGLSLSFFSSLR SFFVLLGLGASQSIFSTLLSSFFRAPMSFYDST  
PLGRILSRVSSDLSVVDLDAFKFSFAVGA AINTYASFGVLA I LAWEFV FVILPTIYLSILIQRYYLATGKE  
LMRINGTTKSFVASHLAESIAGAMTIRAFGEEDRHFSKNLDFIDINASPFFYNFTANEWLIQRLEILCAIVL  
SSSALAL TSLHTSASKSGFIGMALS YGLSMNVFLVFSVQNQCHLANMIVSVERLEQYTNIPSEAPEVRYRLN  
APLVLQGISCKFGGGQKIGIVGRTGSGKTTLSALFRLVEPTGQIIIDGINISTIGLHDLRSRLGIIPQEP  
TLFSGSIRC NLDP LSLHTDEEIWEVLEKQCQLRGAVQEKEEGLDSL VVLDGSNWSMGQRQLFCLGRALLKRSR  
ILVLDEATASIDNATDSILQKTI RTEFADCTVITVAHRIPTVMDC TMVLAISDGKLVEYDEPMKLIKESL  
FGQLVKEYWSHSSNGSNTSGDWL

>VvABCC18

MGESLWTVFCGSSWCWSKIGKICSSGFLAIVCPCSCNLNHLVISVDIIVLLYLLFIFIYKASAMKILSPQQS  
RCFSTMLNSAAFLNGSLGLVYLG LGFWIVGEKLI SEENTILPLHGWL VVLLQGF TWFFLGLAVRFRKHQLLHN  
AGLRLCSVLAFFIAGFPCVT SFWEAIVGDAVSVKVILDVISFPGAILLMFCTFTGPKYAGTDSGFDGAAFYR  
PLPGE GSSAGDKINTDASLPPFEKAGLISRMSFWWLNLSMKKGKQKTLEDKDIPQLRREDRAEMCYLMFMEQ  
QNKQKQSSDSPSILSTILLWQWKQILISGFFALMKVLTSTGPLFLRAFILVAEGKEAFKYEGYALTGGLF  
LTKCLESLSERQWFFRTRLIGLQVRSFLSAAIYQKQLKLSNTAKGLYSPAQIVSFVIIDAYNIGEFYWFHQ  
IWSTSLQLCLALLIIYYSVGLATIAALFV VILTVVANSPMGR LQHKYQKMLMGTQDKRLKAFTEALTNMKSL  
KLYAWETHFKNVIERLRKEEFKWLVS VLSQKGYSLILFWSSPIVVS AITFTACYFIGTTLSASNVTFFMASL



RIAQEP IRLIPDVITAFIEAKVSLDRIAKFLDAPELQNKHVRKMC D GKEEESIFIKSNRISWEDNSTRATL  
RNINLVKPGERVAICGEVSGSKSTLLAAILGEVPHINGIVRVYGKIAYVSQTAWIPTGTIQENILFGSAMD  
PYRYREAIEKCALVKDLEMLPFGDLTEIGERGVNLSGGQKQRVQLARALYQDADVYLLDDPFSAVDAHTATS  
LFNEYVMGALSTKTIVLVTHQVDFLPAFDSVLLMSEGEILQAATFEQLMHSSQEFQDLVNAHNATVRSERQP  
EHDSTQKSKIQKGEIQKIYTEKQLRETSGEQLIKKEERETGDTGLKPYLQYLKYSKGFLYFFLATLSHITFI  
VEQLVQNYWLAANIHNSSVSQKLITVYTGIGLSLSLFLLLRSFFVLLGLGASQSFSTLLSSLFRAFMSF  
YDSTPLGRILSRVSSDLSVVDLDVAFKFTVAVGTTMAYANFGVLTILAWELVFVILPTIYLSILIQRYYFA  
AGKELMRINGTTKSFVASHLSESIAGAMTIRAFGEEDRHFSKNLGFIDMNASPPFFYSFTANEWLILRLEILS  
AIVLSSSGLALTLHTSTSKSGFIGMALSYGLSANVFLVFSVQNCCHLANMIVSVERLEQYTNIPSEAPEVI  
ESNRPPVSWPTIGEVEIYDLKVKYRPNAPLVLHGISCKFGGGQKIGIVGRTGSGKTTLISILFRLVEPTEGQ  
I I IDGIDIATIGLHDLRSRLGIIPQEPTLFGSVRYNLDPLSLHTDEEIWVLEKQCQLRGAVQEKEEGLDSL  
VVQDGSNWSMGQRQLFCLGRALLRRSRILVLEATASIDNATDSILQKTIRTEFADCTVITVAHRIPTVMDC  
TMVLAISDGKLV EYDEPMKLIKKEGSLFGQLVKEYWSRSSNGSNASGDWL

>VvABCC19

MGETLWTVFCGSSWCWSKIGKICSSGFLAIICPCSCNLHILVISVDIILLFYLLFIFIYKAPAVKILSPQQS  
ICFSTMLNSAVFLNGSLGLVYLGLGFVIVGEKLT KENTILPLHGWLVL LQGFTWFFLGLAVRFKRHQLLHN  
AGLRLCSVLAFSIA GFTCVTSFWEAIVGDAVSVKVILDVISFPGAILLMFCTFSEP KYAGTDSGFDGAAYT  
PLPGE GSGGDKINTDASLPPEKAGLISRLSFWWLNLMKKGKQKTLEDKDIPQLRREDRAEMCYLMFMEQ  
QNKQKKQSSDPSILSTILLWQRKQILISGFFALMKVLT LSTGPLFLRAFILVAEGREAFKYEGYALTGGLF  
LIKCLESLSERQWFFRTRLIGLQVRSFLSAAIYQKQLKLSNAAKGSYSPGQIINFVTIDAYNIGEYPYWFHQ  
IWSTSVQLCLALIIIIYYSVGLATIAALFVILTVVANSPMGR LQHKYQKMLMGTQDKRLKAF AEALTNMKS L  
KLYAWETHFKNVIERLRKEEFKWL LSVLSQKGYNLILFWSSPIVVS AVTFWACYFLGTTLSASNVTFMASL  
CIAQEP IRLIPDVISAFIEAMVSLDRIAKFLDAPELQNKHVRKMC D GMELAESVFIKSKRISWEDNSTRATL  
RNINLVKPGEKVAICGEVSGSKSTLLAAILGEVPHVNGIVRVYGKIAYVSQTAWIPTGTIQENILFGSAMD  
PYRYREAIEKCALVKDLEMLPFGDLTEIGERGVNLSGGQKQRVQLARALYRDADVYLLDDPFSAVDAHTATN  
LFNEYVMGALSMKTIVLVTHQVDFLPAFDSVLLMSEGEILQAATFDQLMHSSQEFQDLIIAHNATVRSERQP  
EHDSTQKSKI PKGEIQKIDSEKQLRDSLGEQLIKKEERETGDTGLKPYLQYLKYSKGLYFFLANLSHIFI  
VAQLVQNYWLAANVQNPSVSQKLIAVYTGIGLSLSIFLLRSFFV VVGLGASQSFSTLLSSLFRAFMSF  
YDSTPLGRILSRVSSDLSVVDLDMAFKFTFAIGA AVTTYASFGVLA I LAWELVFVILPTIYLSILIQRYYFA  
AGKELMRINGTTKSFVASHLAESIAGAMTIRAFGEEDRHFSKNLDFIDINASPPFFYSFTANEWL IQRLEILC  
AIVLSSSALALTLHTSSSKSGFIGMALSYGLSVNVFFVFS AQSQCLLANMIVSVERLEQYMNIPSEAPEVI  
GSNRPPPSWPTIGEVEIYDLKVKYRPNAPLVLQGISCKFGGGQKIGIVGRTGSGKTTLISALFRLVEPTEGQ  
I I IDGINISTIGLHDLRSRLGIIPQEPTLFGSIRY NLDPLSLHTDEEIWEVLGKCQLRGAVQEKEEGLDSL  
VVHDGSNWSMGQRQLFCLGRALLKRSRILVLEATASIDNATDSILQKTIRTEFADCTVITVAHRIPTVMDC  
TMVLAISDGKLV EYDVPMKLIKKEGSLFGQLVTEYWSRSSNGSNASGDWL

>VvABCC20

MAGLEAMVPYSGIGFLLNPTSLRAFSASFHLVLLFLFVSWACKIKMGALENCRTGFSYKQIFVCCGL  
SVFNALFFLNIFYWYKNGWSDEQLVTLSDLALRTFAWATVCVYLHTQFLGSVEPKFPFLRVWVWGFYFSIS  
CYCLVIDIVKQHQSQPIQFLVPDAVYVITGLFLCYLGLWGKNQGEESILRESLLHGSASISTRVASNKSKE  
ETVTPFSNAGVFSLLTFSWMGPLIALGNKKTLDLEDV PQLDAVNSVVGGFPIFRSKLEGDGGGGSGVTTKL  
VKAMILSAWAEILL SALLYTLASYVGPYLIDTFVQYLNQRQFKNEG YFLVSAFLVAKLVECLSMRHW  
FRLQQVGIRMR AVLTKIYNKVLAVSYHSKQCHTSGEIINFISVDAERIGDFGWYMHDPWMTLQVALALLI  
LYKNLGLASIAAFFATVIIMLANVPLAKFQEKFDKLMESKDKRMKSTSEILRNMRI LKLGWEMKFLSKIV  
DLRKNETGWLKKYVYTLAITTFVFWGPIFVSVVSGFTAMLMGIPLESKILSSLATFRILQEPIYNLPDTI  
SMIAQTKVSLDRIASFRLDDLQPDVVEKLPKGTSSAIEIVNGNFSWDLSSPHPTLKDINLQVHHGMRVAV  
CGAVGSGKSSLLS CILGEVPKISGTLKLSGTKAYVAQSPWIQGGKIEENILFGKEMDRERYERVLDACTLKK  
DLEILPFGDQTVIGERGINLSGGQKQRIQIARALYQDADIYLFDDPFSAVDAHTGTHLFKECLLGLLDSKT  
VYVTHQVEFLPAADLILVMKEGRITQAGKYNDILNYGSDFVELVGAHKKALSALIESIEAEKSSIMS SVDT  
GSTSEVVPKEENRNGQTGNIEGTDGPKAQLVQEEEREKGVGFSVYWKYIT TAYGGALVPFILLSQILFQLL  
QIGSNYWMAWATPVSEDVKPAVGGSTLILVYVALAIGSSLCVLSRAMLVV TAGYRTATILFNKMHSIFRAP  
MSFFDATPSGRILNRASDQSAVDMDIPMVIWKCAF SFIQLLGIIVMSQVWQV FIVFVPMIATCIWYQRY  
YISSARELARLVGVCKAPVIQHFSETISGSTTIRSF DQESRFRDTNMKLIDGYTRPKFN SAAAMEWLCFRLD  
VLSSITFAFSLVFLISIPEGAIDPGIAGLAVTYGLNLNTLQAWVWNLCNMENKII SVERMLQYTSIPSEPP  
LVMEGNKPACSWPSHG EVDIRDLQVRYAPHLPLVLRGLTCNFPGGMKTGIVGRTGSGKSTLIQTLFRIVEPT  
AGEIMIDGTNISLIGLHDLRSRLSIIPQDPTMFE GTVRSNLDPLEEYSDEQIWEALDKCQLGDEVKKEGKL  
DSAVNENGENWSMGQRQLVCLGRVLLKKS KVLVLEATASVDTATDNLIQQLRQHFDVSTVITIAHRITSV

LDSDMVLLLDHGLIEEHDTPARLLENKSSSFACLVAEYTVRSKSN

>VvABCC21

MVTPYGGIFLLNPIFLRAFSASLHLVLLLLLVSWVCKRIKGSALENCKSTRSLSYKQTFACSQGPSLLNFF  
LCFLNYFYWYRNGWSDEKLVTLDDLVLRTLAWGAVCVYLHTQFHGSGVGPFPFLLRVWVWGFYFSISCYCLVI  
DIVKKHQSLPIQFLVPDIVVITGKNQDEESILREPLLNSTISRVESDKSKGEATVTPFSKAGFFSLLPF  
SWMGPLIAEGNKKTLDLEGVPLDTSNSVVGIFPAFRNKFQCD SAGESIDLCLGRILVTAPFALLNTLAS  
VGPYLIDAFVQYLNGRREFKNEG YLLVMAFFVANLVECLSVRHWFRLAQIGIRAVLITMIYNKGLTSC  
QSKQGHSTGEIINFMSVDAERIGVALALLILYRNLGLASVAFFETVIVMLTNVPLGKWKQFQDKLMESKD  
KRMKATSEILRNMRIKLGWEMKFLSKIMDLRKNETGWLKLYLTLAMTTFVLLGAPTFVSVVTFGTCMLL  
GIPLESKILSSIAFRILQPIYHLPDLISAIQAQTKVSLDRIASFLCLDDLQSDVIERLPKGSSDTAIEIV  
DGNFSDWLDSSPNPTLKDINLRVCRGMRVSVCGTVGSGKSSLLSCMLGEVPKISGILKLCGKAYVAQSPWIQ  
SGKIEENILFGKEMDRERYERVL DACSLKDDLEALSFGDQTVIGERGINLSSGGQKQRIQIARALYQNTDIYL  
FDDPFSAVDARTETHLFKECLLGLLGSKTVIYVTHQVEFLPTADLILVVKDGMITRAGKYNEILNSGTD FME  
LVGAHEKALKLSIHEDSDNIGGTSEVVEKEENKGGQNGKAEGIDGPKGQLVQEEEREKGEVGLRVYWKYIRT  
AYGGALVPFILLSQILFQLLQIGSNYWMAWASPVSDVVKPAVRGSTMIVYVALAVGSSFCVLSRAMLLVTA  
SYKTATIVFNKMHLSLFRAPMSFFDATPSGRILNRASDQNAIDTNIPMQVGAFASFILRLAIIVAMSQVA  
WQVFIVFIPVIATCIWYQQYYISSARELSRLARVCKAPVIQHFSETISGSMTVRSFQESRFDKDTNMKLV  
GYLRPKFNIAGAMEWLCFRDLMLSSVTFASFVFLISVPEGVIDPGIAGLAVTYRLTLNMLQFGVIWSL CNT  
ENKIISVERILQYTSIPSEPPLVIEENRPACSWPSYQVQDIQDLQVRYAPHMPLVLRGLTCTFPGGMKIGIT  
LFRIVEPAAGQIMIDGTNISSIGLHDLRSRLSIIPQDPTMFDGTVRSNLDPLEEYSDGQTWEALDKCQLGDE  
VRKKEGKLDSTVIENGENWSMGQRQLVCLGRLLKSKVLVLDEATASVDTATDNLIQQLRQHFDVSTVIT  
IAHRITSVLSDSDMVLLLDHGLIEEYDTPRLLENKSSSFACLVAEYTVRSNSSENAGDI

>VvABCC22

MVTYSDIVKRHQSLRIQYLPDIVVITGLFLCYSGFLGKNQGEESILREPLLNSTISRVESNKSKEAT  
VTPFSKASFFSLLTFSWIGPLIAEGNKKTLDLEDVPLDTSNSVAGVFPFASNKLQCDSSGSSGVTTLLKLVK  
ALIFACWAEILLTAFLVLVNTLASVGPYLIDTFVQYLNGRREFKNEG YLLAMAFFVAKLVECLSIAQSPWI  
QSGKIEENILFGKEMERERYERVL DACSLKDDLEVL SFGDQTVIGEWGINMSGGQKQRIQIARALYQNAIY  
LFDDPFSAVDAHTGTHLFKECLLGLLGSKTVIYVTHQVEFLPAADLILVMKDGRVTQAGKYNEILNSGTD FM  
ELVGAHKKALLALNSVEAGSLSEKLEKNGGQNGKAEEIDGKQQLVQEEEREKGVGLWVYWKYIRTAYGG  
ALVPFILLSQILFQLLQIGSNYWMAWASPVSDVVKPAVRGSTLIIIVYVALAVGSSFCVLSRAMLLV TAGYKT  
ATILFNKMHLCVFRAPMSFFDATPSGRILNRASDQSTIDTTMPMQVGAFQFIQLLGLIIAVMSQVAWQVF  
IVFIPVIATCIWYQQYYIPSARELSRLAGVCKAPVIQHFSETIAGSMTIRSFQESRFRDTNMKLV DGYIRP  
KFNIAGAMEWLCFRDLMLSSATFAFSLVFLISVPEGVIDPGIAGLAVTYGLNLMIQAWVIWNL CNMENKII  
SVERILQYTSIPSEPPLVTEENRLACSWPSHGVEDIQDLQVRYAPHMPLVLRGLTCTFLGGMKTGIVGRTGS  
GKSTLIQTLFRIVEPAAGQIMIDGTNISSIGLHDLRSRLSIIPQDPTMFEFTVRSNLDPLEEYSDEQIWEAL  
DKCQLGDEVRKKEGKLD SAVEDIENGENWSMGQRQLVCLGRVLLKSKVLVLDEATASVDTATDNLIQQLRQH  
FVDSTVITIAHRITSVLSDSKVLLLDHGLIEEYDTPRLLENKSSSFACLVAEYTVRSHSNLENAGDI

>VvABCC23

MVTPYGGTGFLLNPVFLRVFSASLHLVLLLLLVSWVCKRIKGGAPENCKRTRFLYKQTFACCGLSLLNLL  
LCFLNYFYWYRNGWSDERLVTLDDLVLRTLAWGAVCVYLHTQFIGSVEPKFPFLLRVWVWGFYFSISCYFLVL  
DIVKKHQSLRIQYLPDIVVITGLFLCYSGFLGKNQGEESILREPLLNSTISRVESNKSKEATVTPFS  
KAGFFSLLTFSWIGPLIAEGNKKTLDLEDVPLDTSNSVAGVFPFASNKLQCDSSGSSGVTTLLKLVKALIFA  
CWAIEILLTAFLVLVNTLASVGPYLIDTFVQYLNGRREFKNEG YLLAMAFFVAKLVERLSVRHWFRLQVVG  
IRIRAVLITMIYNKGLTSCQSKQGHSTGEIINFMSVDAERIGDFSWYMHDPWMVIVQVTALLILYKNLGL  
ASVAFFFATVIVMLTNVPLGKWKQEFQDKLMESKDKRMKATSEILRNMRIKLGWEMKFLSKIVDLRKNET  
GWLKLYLTSAVTTFFVWGAPTFVSVATFGTCMLLGIPLLESKILSSIAFRILQPEIYSLPDLISMIAQTK  
VSLDRIASFLRLDDLPSDVIERLPKGSSDTAIEIVDGNFSDWLDSSPNPTLKDINLRVCRGMRVAVCGTVGSG  
KSSLLSCMLGEVPKISGILKLCGKAYVAQSPWIQSGKIEENILFGKEMERERYERVL DACSLKDDLEVL SF  
GDQTVIGEWGINMSGGQKQRIQIARALYQNAIYLFDDPFSAVDAHTGTHLFKECLLGLLGSKTVIYVTHQV  
EFLPAADLILVMKDGRVTQAGKYNEILNSGTD FMELVGAHKKALLALNSVEAGSLSEKLSILEDSDNIGGTS  
EVVEKEENKGGQNGKAEEIDGPKGQLVQEEEREKGVGLWVYWKYIRTAYGGALVPFILLSQILFQLLQIGS  
NYWMAWASPVSDVVKPAVRGSTLIIIVYVALAVGSSFCVLSRAMLLV TAGYKTATILFNKMHLCVFRAPMSFF  
DATPSGRILNRASADQSTIDTTMPMQVGAFQFIQLLGLIIAVMSQVAWQVFIVFIPVIATCIWYQQYYIPS  
ARELSRLAGVCKAPVIQHFSETIAGSMTIRSFQESRFRDTNMKLV DGYLRPKFNIAGAMEWLCFRDLMLSS  
VTFASFVFLISVPEGVIDPGIAGLAMTYGLNLMIQARVIWNL CNMENKIISVERILQYTSIPSEPPLVTE

ENRLACSWPSHGVEIDIQLQVRYAPHMPLVLRGLTCTFLGGMKTGIVGRTGSGKSTLIQTLFRIVEPAAGQI  
MIDGTNISSIGLNDLRTRLSIIPQDPTMFEGTVRSNLDPLEEHSDEQIWEALDKCQLGDEVRKKEGKLD  
SAVIENGENWSMGQRQLVCLGRVLLKKS  
KVLVLDLHGLIEEYDTPTRLLENKSSSFAKLVAEYTVRSHSNLENAGDI

>VvABCC24

MVTPYGPVIGFLLNPVFLRAFSASLHLVLLLLLVSWVCKRINGGALENYKRTRFLYKQTFACCGLSLLNFF  
LCFLNYFYWYRNGWSEKLVTLDDLVRRLSWGAVSVYLHTQFHGSVEPKFPFLLRVWVWGFYSISCYCLVI  
DIVKKDQSLQVQFLVPDIVYVITGLFLCYSGFLGNNQGEESILREPLNNGGTSISIVESDESKGEETVTPFS  
KAGFFSLLTFSWIGPLIAEGNKKTLDLGDVPQLDTSNSVAVFPFRNKLQDCGGSNGVTTLKLKALIFA  
FWAEILLTALFLLLDILASYVGPYLIDTFVQYLNRRREFKNEGYVLMVFFLAKLVECLSLRQCSFRLQQVG  
FRIRAVMITMIYNKGLTLCQSKQGHTTGEIINFMSVDAERIGDFIWMHGPWVIVQVTLALLILYKNVGL  
ASVAFFATIIVMLANVPLGKWEKQKLMESKDKRMKATSEILRNMRIKLQGWEMKFLSKIVDLRKNET  
GWLKKYLYTSAMTTFFFVWVPTFVSVVTFGTCLMIGIPLESKILSSLATFRILQQPIYLLPDLISMIVQTK  
VSLDRITSFLRLVDLQSDVIERLPGSSDTAIEIVDGNFSDWDLSSPNPTLKDINLRVCRGMRAVAVCGTVGSG  
KSSLLSCMLGEVPKISGILKLCGTAKYVAQSPWISQSGKIEENILFGKEMDRERYERVLDACSLKKDLEVL  
SFQDQTVIGERGINLSGGQKQRIQIARALYQNADIYLFDDPFSAVDAHTGTHLFKECLLGLLGSKTVIYVTHQV  
EFLPAADLILVMKDGRITQAGKYNEILNSGTDFMELVGAHKKALSALNSVETGSLSEKLSIHEDSDNIGGTS  
EVVEKEENSGGQNGKAEIDGPKGQLVQEEEREKGVGLWVYWNMRTAYGGALVPFILLSQILFQLLQIGS  
NYWMAWASPVSDVVKPAVRGSTLIVYVALAVGSSFCVLSRAMLLVTAGYKTATILFNKMHLVFRAPMSFF  
DATPSGRILNRASTDQSTIDTNIATQVGACAFQLIQLLGIIVMSQVAVQVIVFIPVAATCIWYQQYYIPS  
ARELSRLAGVCKAPIIQHFSETISGSMTIRSFQESRFRDNTMMLIDGYIRPKFSIAGAEIWLFRDLMLSS  
VTFASFVFLISVPEGVIDPGLAGLTVTYGLNLMILAWIWNFCNMENIISVERILQYTSIPSEPPLVIE  
ENRPACSWPSHGQVDIQLQVRYAPHMPLVLRGLTCTFLGGMKTGIVGRTGSGKSTLIQTLFRIVEPAAGQI  
TIDGTNISSIGLHDLRTRLSIIPQDPTMFEGTVRSNLDPLEEYSDEQIWEALDKCQLGDEVRKKEGKLD  
SAVIENGENWSMGQRQLVCLGRVLLKKS  
KVLVLDLHGLVEEYDTPTRLLENKSSSFAKLVAEYTVRSNSLENVADT

>VvABCC25

MVGLVAMVTPDIVKKDQSLQVQFLVPDIVYVITGLFLCYSGFLGKNQKESILREPLNNGGTSISIVESDE  
SKGEETVTPFSKAGFFSLLTFSWIGPLIAEGNKKTLDLGDVPQLDTSNSVAVFPFRNKLQDCGGSNGVT  
TLKLKALIFAFWAEILLTALFLLLDILASYVGPYLIDTFVQYLNRRREFKNEGYVLMVFFLAKLVECLSL  
RQCSFRLQQVGFIRAVMITMIYNKGLTLCQSKQGHTTGEIINFMSVDAERIGDFIWMHGPWVIVQVTL  
ALLILYKNVGLASVAFFATIIVMLANVPLGKWEKQKLMESKDKRMKATSEILRNMRIKLQGWEMKFL  
SKIVDLRKNETGWLKKYLYTSAMTTFFFVWVPTFVSVVTFGTCLMIGIPLESKILSSLATFRILQQPIYSL  
PDLISMIAQTKVSLDRITSFLRLVDLQSDVIERLPGSSDTAIEIVDGNFSDWDLSSPNPTLKDINLRVCRGM  
RAVAVCGTVGSGKSSLLSCILGEVPKISGILKLCGTAKYVAQSPWISQSGKIEENILFGKEMDRERYERVL  
DACSLKKDLEVLDFGQDQTVIGKRGINLSGGQKQRIQIARALYQNADIYLFDDPFSAVDAHTGTHLFKECLL  
GLLGSKTVIYVTHQVEFLPAADLILVMKDGRITQAGKYNEILNSGTDFMELVGAHKKALSALNSVEAGSL  
SEKSSI  
HEDSDNIGGTSEVIEKEENKGGQNGKAEIDGPKGQLVQEEEREKGVGLWVYWKYIRTAYGGALVPFILLS  
QILFQLLQIGSNYWMAWSSPVSDVVKPAVRGSTLMIVYVALAVGSSFSVLSRAMLLVTATILFNKMHL  
SLFRAPMSFFDATPSGRILNRASTDQNAIDTNIIPMVGAFASLIRLRGIIIVMSQVAVQVIVFIPVIATCIWYQ  
ILDQESRFRDNTMMLVDGYLRPKFNIGAMEWLCFRDLMLSSVTFASFVFLISVPEGVIDPGLIAGLAMTYG  
LNLNMIQARVIWNLNENKIISVERILQYTSIPSEPPLVTEENRLACSWPSHGVEIDIQLQVRYAPHMPLV  
LRGLTCTFLGGMKTGIVGRTGSGKSTLIQTLFRIVEPAAGQIMIDGTNISSIGLNDLRTRLSIIPQDPTMFE  
GTVRSNLDPLEEHSDEQIWEALDKCQLGDEVRKKEGKLD  
SAVIENGENWSMGQRQLVCLGRVLLKKS  
KVLVLDLHGLIEEYDTPTRLLENKSSSFAKLVAEYTVRSHSNLENAGDI