

Accessory Publication

Table S1. Deduced amino acid sequences of three isoforms of CA, two isoforms of PEPC, and Asp AT, and one isoform of NAD-ME, Ala AT, and PPDK of *Bienertia sinuspersici* which were using in phylogenetic analysis

CA1

FKKEKYEKNPALFGELSKGQSPKFMVFACSDSRVCPSHVLNFPGEAFVVRNIAN
MVPAFNKTRYAGVGSAAIEFAVLHLKVENIVVIGHSACGGIKGLMSFPDEGPPSTD
FIEEWVKICLPAKAVLAESIGAPFAEQCATCEKEAVNVS

CA2

FKTEKYERNPSLNFNELAKGQSPKFLVFSCSDSRVCPSHVLGFQPGEAFSVRNIAN
MVPPYDKTRYSGAGAAIEYAVLHLKVENIVVIGHSACGGIKGMSIPDDGSTATDF
IEDWVKICNPARNKVKAELKSADFAVQCENCEKEAVNVS

CA3

FKKEKYEKNPALFGELSKGQSPKFMVFACSDSRVCPSHVLNFQPGEAFFVRNIA
NMVPAFNKTRYAGVGSAAIEIAVLHLKVENIVVIGHSAC

PEPC1

EYRSVVRKEPRFVEYFRLATPELEYGRMNIGSRPSKRKPSGGIESLRAIPWIFSWT
QTKFHLPVWLGFGAAFKHVQKDAKNLNMLKEMYNKWPFFRVTIDL VEMVFA
KGDPGIAALYDKLLVTEELKSFGKHLRDNYEETKQLLLEVAGHKDLLEGDPYLK
QRLRLRDPYITTLNVCQAYTLKRIRDPDFHVTVRPHLSKEIMESNSLAAELVKNL
PTSEYPP

PEPC2

EYRSVVRKEPRFVEYFRLATPELEYGRMNIGSRPSKRKPSGGIESLRAIPWIFSWT
QTKFHLPVWLGFGAAFKHVLQKDIRNLNMLKEMYNEWPPFRVTIDL VEMVFAK
GDPGIAALYDKLLVSEELKSFGKHLRDNYEETKLLLEVAGHKDLLEGDPYLKQ
RLRLRDPYITTLNVCQAYTLKRIRDPDFHVTVRPHLSKEIIESNNLAAELVKNLPT
SEYPP

Asp AT1

GTGSLRVGTEFLARHYHQRTIYIPQPTWGNHPKVFTLGGLNVKSYRYYPATRG
LDLQGLLEDLNAADSGAIVLLHACAHNPTGVDPTREQWEQIRQLIRSKALLPFFD
SAYQGFASGSLDEDAQSVRMFVADGGECFIAQS YAKNMGLYGERVGALSIVCK
TADVASKVESQLKL VVRPMYSSPIHGASIVASILKDKDL YDEWTVELKGMADR
IISMRRQQLFDALTARGTPGDWSHIKQIGMFTFTGLNAEQVIFMNKEYHIYMTSD
GRISMAGLSIQTVPHLAEAIHAA

Asp AT2

GTGACRLFADFQKRYQPESEIYPVPTWANHHNIWRDAHVPQKTYHYYPESKGLDFSGMMNDIKNAPKGSFFLLHACAHNPTGVDPTEEEWKEISQLIKDKGHFPFFDMAYQGFFATGDTERDAKAIRIF

NAD-ME

SIVSFEQQYDRFMESYRSLEKNTEGQSEGSIALAKWRILNRLHDRNETLYYRVLI
DNIKDFAPIIYTPTVGLVCQNYSGLFRRPRGMYFSAKDKGEMMSMIYNWPSQRV
DMIVVTDGSRILGLGDLGVQGIGIAIGKLDVYVAAAGMNPQRVLPIMLDVGTNN
QELVEDPLYLGLRQPRLDGEEYLAILDEFMEAIH

Ala AT

QIPGRATGAYSHSQGIKALRETIAAGMEVRDGFANPNDFLTDGASPGVHMMM
QLLLRSEQDGILCPIPQYPLYSASIALHGGTLVPYYLDEATGWGLEIKDLKSQLES
ARSKGVTVRALVVINPGNPTGQVLAEDNQQKQIVEFCKKEGLVLLADEVYQENV
YAPDKEFHFSFKKIARSMGYEDKDIPLVSYQSVSKGYGECGKRGGYMEVTGFSP
EIREQIYKVASVNLCSNITGQILASLIMNPPKVGDESYETYSAEKEGILSSLARRAK
TLEDAFNSLEGVTCNKAEGAMYLFPRLQLSQFYARRLLQETGIVVVPGSFGQV
PGTWHIRCTILPQEDKIPGIVERLTA FHKKFMDEFRD

PPDK

MALCFKGMLIRSAPDVFTHTLGYMKDQYQVGCSCNSFQRVQFRNRRRCPHRL
TSQSQSNRQDVMALISDPVSTTTQQRVFTFGKGRSDGDKSMKSLGGKGANLAE
MASIGLSVPPGLTISTEACQEYQDSGKMLPESLWEEILEGLRVIESDMGAYLGDSS
TPLLLSVRSGAAISMPGMMDTILNLGLNDEVVSGLA AKSGERFAYDSFRRFLDM
FGCVVMGIPHSSFEKLEKLEKQMKGVKLDTEL TASDLKELAEQYKNVYIETKGE
VFPADPKKQLQLAVQAVFDSWDSRAVKYRSINQISGLKGTA VNIQSMVFGNM
GNTSGTGVLFRNPNTGERKLYGEFLINAQGEDVVAGIRTPEDLDTMKSCMPEA
YTELVQNCEILEQHYKDMMDIEFTVQENRLWMLQCRSGKRTGKGAVKIAIDMV
NEGKINSRTAIKMVEPQHLDQLLHPQFEDASAYKERVITSGLPASPGAAVGQIVF
SAYDAEAWHAQGSAILVRNETSPEDVGGMHAAAGILTARGGMTSHAAVVAR
GWGKCCVSGCSEIKVNETNKSLVVGNNVLTEGDWLSLNGSTGEVILGKEPLSPP
ALSGDLETIMSWTDAVRRLKVMANADTPEDALAARNNGAEGIGLCRTEHMFFA
SDDRIKAVRKMIMAVTPEQRKAALDQLLPYQRSDFEGIFRAMDGLPVTIRLLDPP
LHEFLPEGDLQQIVNELASETGITEDEVYSRVEKLSEVNPMLGFRGCRLGISYPEL
TEMQARAVFQAAVSMTNQGITVLPEIMVPLVGTTPQELGHQVNLIRSVATKVFSE
MGSSVRYKVGTMIEIPRAALVADEIAVEADFFSFGTNDLTQMTFGYSRDDVVKF
LPIYLSNGILQTDPFVLDQKGVGQLIKLATEKGRAAKPSLKVGICGEHGGEPSSV
AFFAEAGLDYVSCSPFRVPIARLAAAQVAV

Table S2. Homology from sequence information on transcripts from *Bienertia sinuspersici* of C₄ pathway gene homologues compared to some available sequences on orthologues of the enzymes from some representative C₃ and C₄ species.

Carbonic Anhydrase

	<i>Bienertia sinuspersici</i> CA1	<i>Bienertia sinuspersici</i> CA2	<i>Bienertia sinuspersici</i> CA3	<i>Spinacia oleracea</i>	<i>Flaveria pringlei</i> CA1	<i>Flaveria bidentis</i> CA1	<i>Flaveria pringlei</i> CA2	<i>Flaveria bidentis</i> CA2	<i>Flaveria pringlei</i> CA3	<i>Flaveria bidentis</i> CA3	<i>Arabidopsis thaliana</i>	<i>Oryza sativa</i>	<i>Zea mays</i>
<i>Bienertia sinuspersici</i> CA1	100												
<i>Bienertia sinuspersici</i> CA2	76	100											
<i>Bienertia sinuspersici</i> CA3	97	81	100										
<i>Spinacia oleracea</i>	85	77	89	100									
<i>Flaveria pringlei</i> CA1	75	73	77	77	100								
<i>Flaveria bidentis</i> CA1	76	73	78	78	99	100							
<i>Flaveria pringlei</i> CA2	72	77	79	76	72	72	100						
<i>Flaveria bidentis</i> CA2	72	77	79	75	72	72	99	100					
<i>Flaveria pringlei</i> CA3	76	73	82	80	86	86	73	73	100				
<i>Flaveria bidentis</i> CA3	77	73	83	82	84	84	73	73	96	100			
<i>Arabidopsis thaliana</i>	60	65	64	63	60	60	68	68	60	60	100		
<i>Oryza sativa</i>	62	59	69	61	58	58	58	58	62	61	52	100	
<i>Zea mays</i>	64	60	67	62	60	60	60	60	64	63	56	80	100

Phosphoenolpyruvate carboxylase (C₄ isoform and C₃ isoform refer to isoform of PEPC from C₄ plant; C₃ refers to PEPC from C₃ plant.

	<i>Bienertia sinuspersici</i> PEPC1	<i>Bienertia sinuspersici</i> PEPC2	<i>Bienertia sinuspersici</i> Lara et al. 2006	<i>Suaeda aralocaspica</i> C ₄ isoform	<i>Suaeda linifolia</i> C ₃	<i>Amaranthus hypochondriacus</i> C ₄ isoform	<i>Alternanthera pungens</i> C ₄	<i>Arabidopsis thaliana</i> C ₃	<i>Zea mays</i> C ₃ isoform	<i>Zea mays</i> C ₄ isoform	<i>Sorghum bicolor</i> C ₃ isoform	<i>Sorghum bicolor</i> C ₄ isoform	<i>Saccharum officinarum</i> C ₄ isoform	<i>Oryza sativa</i> C ₃
<i>Bienertia sinuspersici</i> PEPC1	100													
<i>Bienertia sinuspersici</i> PEPC2	96	100												
<i>Bienertia sinuspersici</i> Lara et al. 2006	80	81	100											
<i>Suaeda aralocaspica</i>	80	81	98	100										
<i>Suaeda linifolia</i> C ₃	81	82	91	92	100									
<i>Amaranthus hypochondriacus</i> C ₄ isoform	82	81	78	78	77	100								
<i>Alternanthera pungens</i> C ₄	85	84	78	78	78	85	100							
<i>Arabidopsis thaliana</i> C ₃	80	81	78	79	81	74	78	100						
<i>Zea mays</i> C ₃ isoform	83	85	79	79	80	75	78	82	100					
<i>Zea mays</i> C ₄ isoform	76	77	72	73	71	75	77	71	73	100				
<i>Sorghum bicolor</i> C ₃ isoform	83	85	80	80	82	76	79	83	95	73	100			
<i>Sorghum bicolor</i> C ₄ isoform	73	73	68	68	67	75	73	67	70	93	69	100		
<i>Saccharum officinarum</i> C ₄ isoform	77	78	73	73	71	77	76	71	73	92	73	94	100	
<i>Oryza sativa</i> C ₃	83	84	80	80	82	75	80	85	89	73	91	69	73	100

Aspartate aminotransferase

	<i>Bienertia sinuspersici</i> Asp AT1	<i>Bienertia sinuspersici</i> Asp AT2	<i>Arabidopsis thaliana</i> Chloroplast	<i>Daucus carota</i> Cytosol	<i>Glycine max</i> Chloroplast	<i>Canavalia lineata</i> Chloroplast	<i>Panicum miliaceum</i> Chloroplast	<i>Panicum miliaceum</i> Cytosol	<i>Panicum miliaceum</i> Mitochondria	<i>Oryza sativa</i> Chloroplast
<i>Bienertia sinuspersici</i> Asp AT1	100									
<i>Bienertia sinuspersici</i> Asp AT2	48	100								
<i>Arabidopsis thaliana</i> Chloroplast	53	55	100							
<i>Daucus carota</i> Cytosol	85	54	55	100						
<i>Glycine max</i> Chloroplast	53	56	88	56	100					
<i>Canavalia lineata</i> Chloroplast	52	52	85	54	92	100				
<i>Panicum miliaceum</i> Chloroplast	55	56	88	56	85	84	100			
<i>Panicum miliaceum</i> Cytosol	82	50	53	83	53	51	53	100		
<i>Panicum miliaceum</i> Mitochondria	51	81	49	53	48	47	49	51	100	
<i>Oryza sativa</i> Chloroplast	55	56	87	56	84	83	95	53	50	100

NAD-malic enzyme (alpha and beta refer to the two different subunits)

	<i>Bienertia sinuspersici</i> NAD-ME	<i>Arabidopsis thaliana</i> beta	<i>Solanum tuberosum</i> beta	<i>Solanum tuberosum</i> alpha	<i>Amaranthus hypocondriacus</i> alpha	<i>Arabidopsis thaliana</i> alpha	<i>Solanum tuberosum</i> alpha	<i>Oryza sativa</i> alpha
<i>Bienertia sinuspersici</i> NAD-ME	100							
<i>Arabidopsis thaliana</i> beta	81	100						
<i>Oryza sativa</i> beta	84	73	100					
<i>Solanum tuberosum</i> beta	87	77	75	100				
<i>Amaranthus hypocondriacus</i> alpha	69	62	63	62	100			
<i>Arabidopsis thaliana</i> alpha	70	62	64	63	78	100		
<i>Solanum tuberosum</i> alpha	72	62	65	64	80	85	100	
<i>Oryza sativa</i> alpha	74	65	66	68	78	81	82	100

Alanine aminotransferase

	<i>Bienertia sinuspersici</i>	<i>Arabidopsis thaliana</i>	<i>Glycine max</i>	<i>Zea mays</i>	<i>Panicum miliaceum</i>	<i>Oryza sativa</i>
<i>Bienertia sinuspersici</i>	100					
<i>Arabidopsis thaliana</i>	82	100				
<i>Glycine max</i>	82	84	100			
<i>Zea mays</i>	79	78	78	100		
<i>Panicum miliaceum</i>	81	80	80	93	100	
<i>Oryza sativa</i>	80	79	79	90	91	100

Pyruvate, Phosphate, dikinase

	<i>Bienertia sinuspersici</i>	<i>Mesembryanthemum crystallinum</i>	<i>Flaveria bidentis</i>	<i>Falveria trinervia</i>	<i>Flavera brownii</i>	<i>Flaveria pringlei</i>	<i>Arabidopsis thaliana</i>	<i>Oryza sativa</i>	<i>Zea mays</i>	<i>Sorghum bicolor</i>
<i>Bienertia sinuspersici</i>	100									
<i>Mesembryanthemum crystallinum</i>	81	100								
<i>Flaveria bidentis</i>	77	77	100							
<i>Falveria trinervia</i>	77	76	99	100						
<i>Flavera brownii</i>	77	78	93	93	100					
<i>Flaveria pringlei</i>	77	78	94	94	96	100				
<i>Arabidopsis thaliana</i>	82	82	81	77	83	83	100			
<i>Oryza sativa</i>	74	74	74	73	76	76	80	100		
<i>Zea mays</i>	73	74	72	71	74	74	79	84	100	
<i>Sorghum bicolor</i>	73	72	73	72	74	74	79	83	89	100