

Supplementary Information

The BRCT domain enhances DNA binding and catalytic efficiency of fungal PARPs

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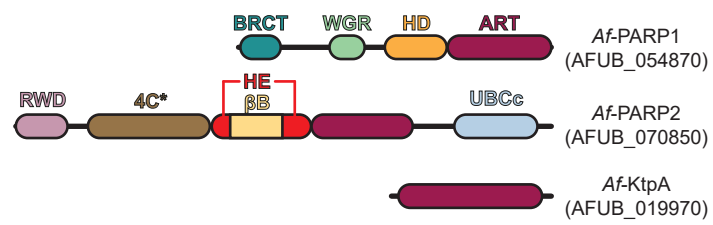
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Figures

Supplementary Figure 1. Schematic representation of *A. fumigatus* PARPs.

Abbreviations: RWD, after the three major 4C*, PARP6/8-type C4 zinc finger; β B, beta-barrel; HE, helical extension; RWD-containing proteins: RING finger-containing proteins, WD-repeat-containing proteins, and yeast DEAD (DEXD)-like helicases; UBCc, ubiquitin-conjugating enzyme E2 catalytic domain

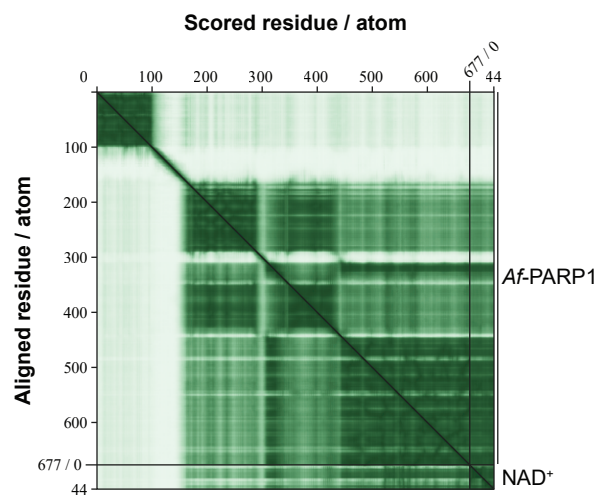
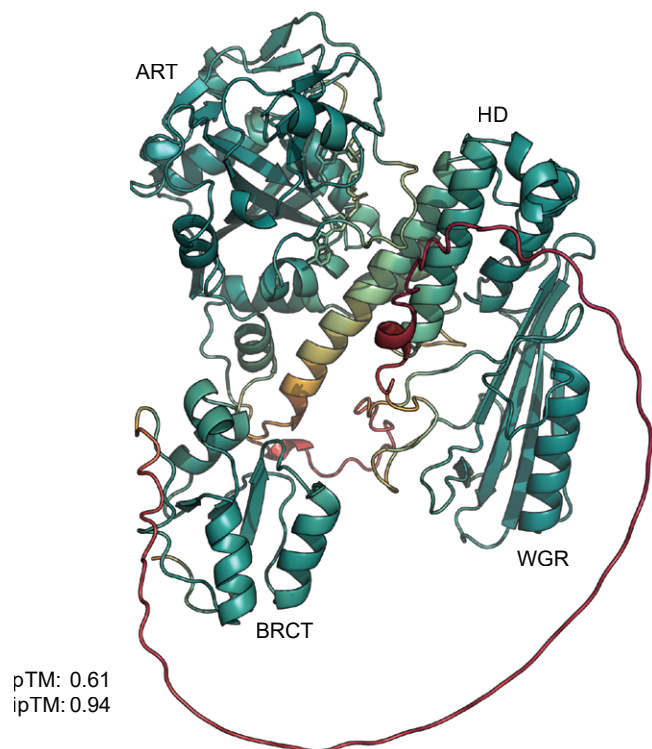
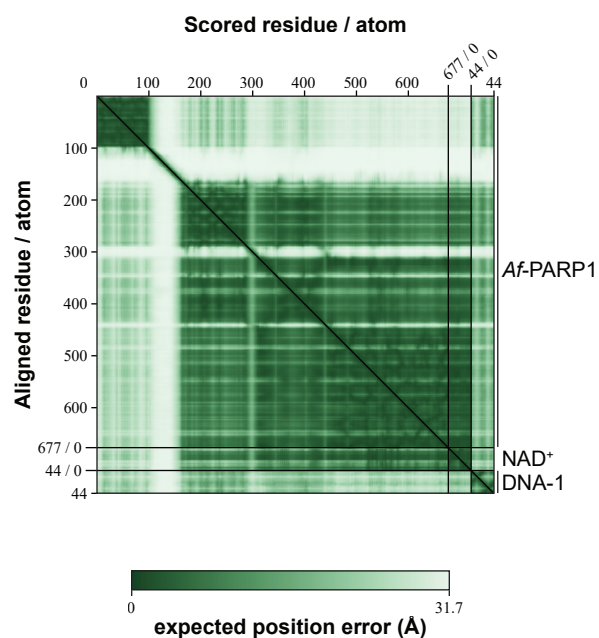
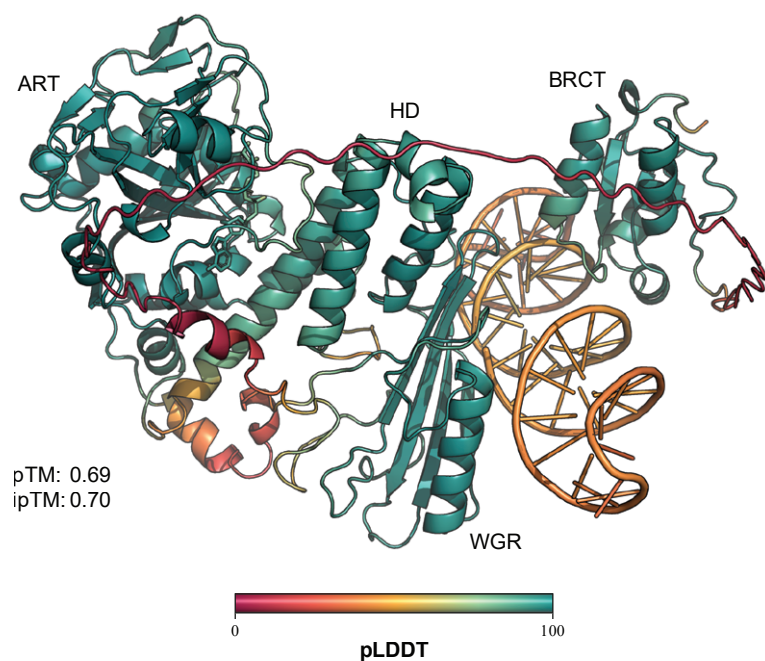
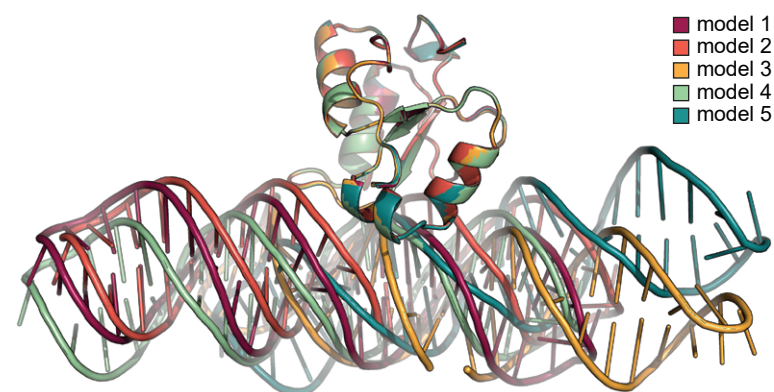


Supplementary Figure 1

Supplementary Figure 2. AlphaFold models of *Af*-PARP1 and its DNA complex.

(a and b) Per-residue confidence estimate (pLDDT) mapped onto the predicted structures for *Af*-PARP1:NAD⁺ (a) and *Af*-PARP1:NAD⁺:DNA-1 (b) are shown in the left panels. The predicted alignment error (PAE) of the predicted complexes are shown in the right panels.

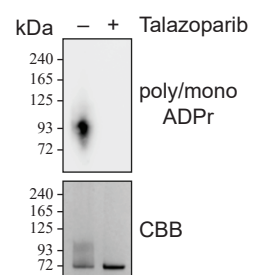
(c) Model-to-model comparison for the BRCT:DNA-1 interaction. BRCT domains and DNA were extracted from their respective full-length *Af*-PARP1 models before alignment (r.m.d.s. scores ≤ 0.092 Å).

a**b****c**

Supplementary Figure 2

Supplementary Figure 3. Talazoparib is an efficient *Af*-PARP1 inhibitor.

The influence of talazoparib, a *h*PARP1 inhibitor, on the catalytic activity of *Af*-PARP1 was assessed. *Af*-PARP1 (0.5 μ M) was incubated in presence or absence of talazoparib (1 μ M) with activated DNA and NAD⁺ (500 μ M) and formation of PAR detected using immunoblot.



Supplementary Figure 3

Supplementary Table 1. Sequences used for comparison of fungal, BRCT domain-containing PARPs.

species	phylogenetic class	accession number ⁱ
<i>Ascomycota</i>		
<i>Aaosphaeria arxii</i> CBS 175.79	<i>Dothideomycetes</i>	XP_033387550
<i>Alternaria rosae</i>	<i>Dothideomycetes</i>	XP_046025914
<i>Ascochyta lentis</i>	<i>Dothideomycetes</i>	KAF9695564
<i>Bipolaris sorokiniana</i> ND90Pr	<i>Dothideomycetes</i>	XP_007705677
<i>Corynespora cassiicola</i> Philippines	<i>Dothideomycetes</i>	PSN74498
<i>Decorospora gaudefroyi</i>	<i>Dothideomycetes</i>	KAF1835861
<i>Didymella</i> sp. IMI 355093	<i>Dothideomycetes</i>	KAJ4376697
<i>Didymosphaeria variabile</i>	<i>Dothideomycetes</i>	XP_056068963
<i>Diplodia corticola</i>	<i>Dothideomycetes</i>	XP_020125224
<i>Dothidotthia symphoricarpi</i> CBS 119687	<i>Dothideomycetes</i>	XP_033519213
<i>Lasiodiplodia hormozganensis</i>	<i>Dothideomycetes</i>	KAK0663694
<i>Lentithecium fluviale</i> CBS 122367	<i>Dothideomycetes</i>	KAF2675763
<i>Lizonia empirigonia</i>	<i>Dothideomycetes</i>	KAF1364362
<i>Ophiobolus disseminans</i>	<i>Dothideomycetes</i>	KAF2828069
<i>Paraphoma chrysanthemicola</i>	<i>Dothideomycetes</i>	KAH7081044
<i>Periconia macrospinoso</i>	<i>Dothideomycetes</i>	PVH96833
<i>Phaeosphaeriaceae</i> sp. PMI808	<i>Dothideomycetes</i>	KAH8731672
<i>Phaeosphaeriaceae</i> sp. SRC1lsM3a	<i>Dothideomycetes</i>	OAL05067
<i>Plenodomus biglobosus</i>	<i>Dothideomycetes</i>	KAH9869979
<i>Stagonosporopsis vannaccii</i>	<i>Dothideomycetes</i>	KAJ4987088
<i>Aspergillus fumigatus</i>	<i>Eurotiomycetes</i>	KAH1273305
<i>Emergomyces africanus</i>	<i>Eurotiomycetes</i>	OAX79141
<i>Fonsecaea nubica</i>	<i>Eurotiomycetes</i>	XP_022497109
<i>Fonsecaea pedrosoi</i> CBS 271.37	<i>Eurotiomycetes</i>	XP_013279927
<i>Histoplasma capsulatum</i>	<i>Eurotiomycetes</i>	QSS65792
<i>Paracoccidioides brasiliensis</i>	<i>Eurotiomycetes</i>	ODH29465
<i>Penicillium antarcticum</i>	<i>Eurotiomycetes</i>	XP_058320424
<i>Phialophora macrospora</i>	<i>Eurotiomycetes</i>	KIW70895
<i>Talaromyces marneffei</i>	<i>Eurotiomycetes</i>	XP_054119787
<i>Geoglossum umbratile</i>	<i>Geoglossomycetes</i>	KAI9780519
<i>Xylographa bjoerkii</i>	<i>Lecanoromycetes</i>	MCJ1389085
<i>Xylographa parallela</i>	<i>Lecanoromycetes</i>	MCJ1418709
<i>Cadophora</i> sp. MPI-SDFR-AT-0126	<i>Leotiomyces</i>	KAH7393623
<i>Hyaloscypha finlandica</i>	<i>Leotiomyces</i>	KAH8773067
<i>Mollisiaceae</i> sp. DMI_Dod_QoI	<i>Leotiomyces</i>	KAE8441035
<i>Pseudogymnoascus</i> sp. VKM F-3775	<i>Leotiomyces</i>	KFY12553
<i>Pseudogymnoascus</i> sp. VKM F-4513 (FW-928)	<i>Leotiomyces</i>	KFY37269
<i>Rhynchosporium agropyri</i>	<i>Leotiomyces</i>	CZS90872
<i>Lichina confinis</i>	<i>Lichinomyces</i>	KAI9755981
<i>Arthrobotrys entomopaga</i>	<i>Orbiliomycetes</i>	KAF3919977
<i>Drechslerella stenobrocha</i> 248	<i>Orbiliomycetes</i>	EWC46572
<i>Orbilium blumenaviensis</i>	<i>Orbiliomycetes</i>	KAK6360592
<i>Orbilium oligospora</i> ATCC 24927	<i>Orbiliomycetes</i>	XP_011123834
<i>Choiromyces venosus</i> 120613-1	<i>Pezizomycetes</i>	RPA93621
<i>Morchella sextelata</i>	<i>Pezizomycetes</i>	XP_044696167
<i>Tirmania nivea</i>	<i>Pezizomycetes</i>	KAF8429243
<i>Tricharina praecox</i>	<i>Pezizomycetes</i>	XP_051340276
<i>Colletotrichum chlorophyti</i>	<i>Sordariomycetes</i>	OLN89070
<i>Colletotrichum higginsianum</i> IMI 349063	<i>Sordariomycetes</i>	XP_018159871
<i>Fusarium graminearum</i>	<i>Sordariomycetes</i>	KAI6751906
<i>Fusarium solani</i>	<i>Sordariomycetes</i>	KAH7264506
<i>Lomentospora prolificans</i>	<i>Sordariomycetes</i>	PKS11272
<i>Madurella fahalii</i>	<i>Sordariomycetes</i>	GAB1313793
<i>Magnaporthiopsis poae</i> ATCC 64411	<i>Sordariomycetes</i>	KLU91359
<i>Neurospora crassa</i>	<i>Sordariomycetes</i>	KAK3502080
<i>Magnaporthe grisea</i> ⁱⁱ	<i>Sordariomycetes</i>	QBZ63443
<i>Podospora anserina</i>	<i>Sordariomycetes</i>	CDP24926
<i>Sordaria macrospora</i>	<i>Sordariomycetes</i>	XP_065946313
<i>Trichoderma guizhouense</i>	<i>Sordariomycetes</i>	OPB37503
<i>Protomyces lactucae-debilis</i>	<i>Taphrinomycetes</i>	XP_040722560
<i>Taphrina deformans</i> PYCC 5710	<i>Taphrinomycetes</i>	CCG83847

species	phylogenetic class	accession number ⁱ
<i>Chytridiomycota</i>		
<i>Batrachochytrium dendrobatidis</i>		KAJ8326010
<i>Batrachochytrium salamandrivorans</i>		KAH6568607
<i>Boothomyces</i> sp. JEL0866		KAJ3319355
<i>Fimicolochytrium jonesii</i>		XP_052926319
<i>Geranomyces variabilis</i>		KAJ3168278
<i>Powellomyces hirtus</i>		TPX54139
<i>Rhizophlyctis rosea</i>		KAJ3046051
<i>Spizellomyces punctatus</i> DAOM BR117		XP_016604037
<i>Synchytrium endobioticum</i>		TPX43361
<i>Thoreauomyces humboldtii</i>		KAJ3021815
<i>Entomophthoromycota</i>		
<i>Basidiobolus ranarum</i>		KAK9708347
<i>Glomeromycota</i>		
<i>Acaulospora colombiana</i>		CAG8530387
<i>Diversispora epigaea</i>		RHZ86579
<i>Funneliformis mosseae</i>		CAG8696709
<i>Geosiphon pyriformis</i>		KAG9290740
<i>Paraglomus occultum</i>		CAG8457874
<i>Rhizophagus clarus</i>		GES76673
<i>Mucoromycota</i>		
<i>Actinomortierella ambigua</i>		KAG0259843
<i>Benniella</i> sp.		KAK3812104
<i>Dissophora ornata</i>		KAF8929984
<i>Entomortierella parvispora</i>		GJJ72712
<i>Linnemannia elongata</i>		KAK3819163
<i>Mortierella</i> sp. AM989		KAF9110161
<i>Neocallimastigomycota</i>		
<i>Anaeromyces robustus</i>		ORX86892
<i>Neocallimastix lanati</i> (nom. inval.)		KAG4108431
<i>Piromyces finnis</i>		ORX55486

(i) GenBank accession number

(ii) GenBank entry gives species name as *Pyricularia oryzae*

Supplementary Table 2. PARP sequences across the *Animalia*, *Fungi*, and *Plantae*.

binominal name	species	common name	accession number ⁱ
<i>Fungi</i>			
<i>Ascomycota</i>			
<i>Alternaria rosae</i>			XP_046025914
<i>Aspergillus fumigatus</i>			KAH1273305
<i>Fusarium solani</i>			KAH7264506
<i>Magnaporthe grisea</i> ⁱⁱ		rice blast fungus	QBZ63443
<i>Podospora anserina</i>		friendly mould	CDP24926
<i>Basidiomycota</i> ⁱⁱⁱ			
<i>Amanita muscaria</i> Koide BX008		fly agaric	KIL70591
<i>Pholiota conissans</i>			KAF9485628
<i>Psilocybe cf. subviscida</i>			KAF5309111
<i>Rhizoctonia solani</i>			KAF8680135
<i>Trametes cervina</i>		deer-coloured trametes	KAI0344320
<i>Chytridiomycota</i>			
<i>Batrachochytrium dendrobatidis</i>		amphibian chytrid fungus	KAJ8326010
<i>Thoreauomyces humboldtii</i>			KAJ3021815
<i>Glomeromycota</i>			
<i>Diversispora epigaea</i>			RHZ86579
<i>Geosiphon pyriformis</i>			KAG9290740
<i>Mucoromycota</i>			
<i>Actinomortierella ambigua</i>			KAG0259843
<i>Linnemannia elongata</i>			KAK3819163
<i>Neocallimastigomycota</i>			
<i>Neocallimastix lanati</i> (nom. inval.)			KAG4108431
<i>Animalia</i>			
PARP1-like			
<i>Apis mellifera</i>		honeybee	XP_624477
<i>Danio rerio</i>		zebrafish	NP_001038407
<i>Gallus gallus</i>		chicken	NP_990594
<i>Homo sapiens</i>		human	NP_001609
<i>Strongylocentrotus purpuratus</i>		Pacific purple sea urchin	XP_030854208
PARP2-like			
<i>Alligator mississippiensis</i>		American alligator	XP_006266632
<i>Danio rerio</i>		zebrafish	NP_001191199
<i>Homo sapiens</i>		human	NP_005475
<i>Narcine bancroftii</i>		lesser electric ray	XP_069796901
<i>Xenopus laevis</i>		African clawed frog	NP_001086535
PARP3-like			
<i>Danio rerio</i>		zebrafish	NP_956795
<i>Gallus gallus</i>		chicken	XP_040537823
<i>Homo sapiens</i>		human	NP_001003931
<i>Rhincodon typus</i>		whale shark	XP_048462464
<i>Xenopus tropicalis</i>		western clawed frog	NP_001120635
<i>Plantae</i>			
PARP1-like			
<i>Amborella trichopoda</i>			XP_011624679
<i>Arabidopsis thaliana</i>		mouse-ear cress	NP_850165
<i>Oryza glaberrima</i>		African rice	XP_052161742
<i>Lathyrus oleraceus</i> ^{iv}		garden pea	XP_050910876
<i>Zea mays</i>		maize	NP_001288538
PARP2-like			
<i>Amborella trichopoda</i>			XP_006855550
<i>Arabidopsis thaliana</i>		mouse-ear cress	NP_001329308
<i>Oryza glaberrima</i>		African rice	XP_052161977
<i>Lathyrus oleraceus</i> ^{iv}		garden pea	PX314872
<i>Sphagnum magellanicum</i>		Magellanic bogmoss	KAH9533036
PARP3-like			
<i>Arabidopsis thaliana</i>		mouse-ear cress	NP_001318618
<i>Nelumbo nucifera</i>		sacred lotus	XP_010271692
<i>Oryza glaberrima</i>		African rice	XP_052145480
<i>Lathyrus oleraceus</i> ^{iv}		garden pea	PX437880

species		
binominal name	common name	accession number ⁱ
<i>Zea mays</i>	maize	XP_008645748

(i) GenBank accession number

(ii) GenBank entry gives species by its anamorph name as *Pyricularia oryzae*

(iii) Fungal PARPs without BRCT domain

(iv) formerly *Pisum sativum*

Supplementary Table 3. DNA damage mimetics used in this study.

name	sequence	scheme ⁱ
DNA-1	[5'P]CGGTCGATCGTAAGATCGACCGGCGCTGGAGCTTGCTC CAGCGC	
DNA-2	[5'P]CGGTCGATCGTAAGATCGACCGTGCCTGGAGCTTGCT CCAGCGC	
DNA-3	CGGTCGATCGTAAGATCGACCGTGCCTGGAGCTTGCTCCA GCGC[3'P]	
DNA-4	GGAAGTTCTTTTGAAGTTCC	
DNA-5	[5'P]GGAAGTTCTTTTGAAGTTCC	
DNA-6	GGAAGTTCTTTTGAAGTTCC[3'P]	
DNA-7	GGAAGTTCTTTTGAAGTTCCCTGG	
DNA-8	GCTAGGAAGTTCTTTTGAAGTTCC	
DNA-9	[5'P]GGAAGTTCTTTTGAAGTTCCCTGG	
DNA-10	GCTAGGAAGTTCTTTTGAAGTTCC[3'P]	
DNA-11	CGGTCGATCGTAAGATCGACCGGCGCTGGAGCTTGCTCCAG CGC	
DNA-12	CGGTCGATCGTAAGATCGACCGGCGCTGGAGCTTGCTCCAG CGC[3'P]	
DNA-13	CGGTCGATCGTAAGATCGACCGTGCCTGGAGCTTGCTCCA GCGC	
DNA16/17	DNA-16: [5'P]GACGACCCGGACACA DNA-17: TGTGCTCCGGGTCGTC	

(i) Schematic representations were created in BioRender. (Rack, J. [2025]) and modified in Adobe Illustrator

Supplementary Table 4. PARP sequences utilised to generate BRCT alignment.

species		
binominal name	common name	accession number ⁱ
Fungi		
<i>Aspergillus fumigatus</i>		KAH1273305
<i>Alternaria rosae</i>		XP_046025914
<i>Fusarium solani</i>		KAH7264506
<i>Podospora anserina</i>	friendly mould	CDP24926
<i>Batrachochytrium dendrobatidis</i>	amphibian chytrid fungus	KAJ8326010
Animalia		
PARP1-like		
<i>Apis mellifera</i>	honeybee	XP_624477
<i>Danio rerio</i>	zebrafish	NP_001038407
<i>Gallus gallus</i>	chicken	NP_990594
<i>Homo sapiens</i>	human	NP_001609
<i>Strongylocentrotus purpuratus</i>	Pacific purple sea urchin	XP_030854208
PARP4-like		
<i>Homo sapiens</i>	human	NP_006428
<i>Notamacropus eugenii</i>	Tammar wallaby	XP_072467755
<i>Gallus gallus</i>	chicken	NP_001164635
<i>Xenopus laevis</i>	African clawed frog	XP_041440456
<i>Rhincodon typus</i>	Whale shark	XP_048454258
Plantae		
PARP1-like		
<i>Amborella trichopoda</i>		XP_011624679
<i>Arabidopsis thaliana</i>	mouse-ear cress	NP_850165
<i>Oryza glaberrima</i>	African rice	XP_052161742
<i>Lathyrus oleraceus</i> ⁱⁱ	garden pea	XP_050910876
<i>Zea mays</i>	maize	NP_001288538
PARP3-like		
<i>Arabidopsis thaliana</i>	mouse-ear cress	NP_001318618
<i>Nelumbo nucifera</i>	sacred lotus	XP_010271692
<i>Oryza glaberrima</i>	African rice	XP_052145480
<i>Lathyrus oleraceus</i> ⁱⁱ	garden pea	PX437880
<i>Zea mays</i>	maize	XP_008645748

(i) GenBank accession number

(ii) formerly *Pisum sativum*