

Supplementary Materials

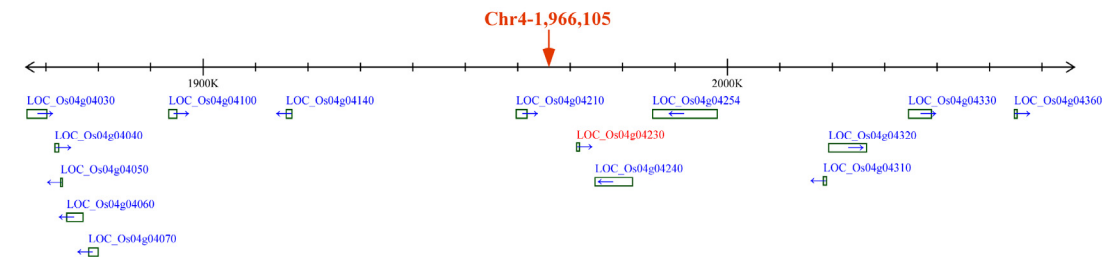


Figure S1. *LOC_Os04g04230* (*GP4*) lies adjacent to the lead SNP (Chr4-1,966,105) of *qGP4* locus.

Lead SNP	Accession name	Position (bp)						
		1,971,215	1,971,303	1,971,565*	1,971,593	1,971,595*	1,971,664*	1,971,671
	Nipponbare (Ref.)	G	T	A	G	G	G	T
C type	NSF-TV 4	T	T	G	G	G	G	TGGCCGCGCTGCCGTGCCGGGTGCTGTACGGATTCCACGGCGTGTATTACCAAGG
	Pagayahan	T	T	G	G	T	G	TGGCCGCGCTGCCGTGCCGGGTGCTGTACGGATTCCACGGCGTGTATTACCAAGG
	RTS14	T	T	G	G	G	G	TGGCCGCGCTGCCGTGCCGGGTGCTGTACGGATTCCACGGCGTGTATTACCAAGG
	Criollo La Fria	T	T	G	G	T	G	TGGCCGCGCTGCCGTGCCGGGTGCTGTACGGATTCCACGGCGTGTATTACCAAGG
	Paraiba Chines Nova	T	T	G	G	T	G	TGGCCGCGCTGCCGTGCCGGGTGCTGTACGGATTCCACGGCGTGTATTACCAAGG
	Ajiaonante	T	T	G	G	T	G	TGGCCGCGCTGCCGTGCCGGGTGCTGTACGGATTCCACGGCGTGTATTACCAAGG
	ECIA76-S89-1	T	T	G	G	T	G	TGGCCGCGCTGCCGTGCCGGGTGCTGTACGGATTCCACGGCGTGTATTACCAAGG
	Djimoron	T	T	G	G	G	G	TGGCCGCGCTGCCGTGCCGGGTGCTGTACGGATTCCACGGCGTGTATTACCAAGG
	Chang Ch'Sang Hsu Tao	T	T	G	G	T	G	TGGCCGCGCTGCCGTGCCGGGTGCTGTACGGATTCCACGGCGTGTATTACCAAGG
A type	JC 117	T	T	G	G	T	G	TGGCCGCGCTGCCGTGCCGGGTGCTGTACGGATTCCACGGCGTGTATTACCAAGG
	9524	T	T	G	G	T	G	TGGCCGCGCTGCCGTGCCGGGTGCTGTACGGATTCCACGGCGTGTATTACCAAGG
	Zhenshan 97B	T	T	G	G	T	G	TGGCCGCGCTGCCGTGCCGGGTGCTGTACGGATTCCACGGCGTGTATTACCAAGG
	Chuan 4	G	A	A	A	G	A	TGGCCGCGCTGCCGTGCCGGGTACCGTACGGATTCCACGGCGTGTATTACCAAGG
	Mehr	G	A	A	A	G	A	TGGCCGCGCTGCCGTGCCGGGTACCGTACGGATTCCACGGCGTGTATTACCAAGG
	Kaukau	G	A	A	A	G	A	TGGCCGCGCTGCCGTGCCGGGTACCGTACGGATTCCACGGCGTGTATTACCAAGG
	DD 62	G	A	A	A	G	A	TGGCCGCGCTGCCGTGCCGGGTACCGTACGGATTCCACGGCGTGTATTACCAAGG
	DJ 123	G	A	A	A	G	A	TGGCCGCGCTGCCGTGCCGGGTACCGTACGGATTCCACGGCGTGTATTACCAAGG
	DJ 24	G	A	A	A	G	A	TGGCCGCGCTGCCGTGCCGGGTACCGTACGGATTCCACGGCGTGTATTACCAAGG
	DK 12	G	A	A	A	G	A	TGGCCGCGCTGCCGTGCCGGGTACCGTACGGATTCCACGGCGTGTATTACCAAGG
	Paung Malaung	G	A	A	A	G	A	TGGCCGCGCTGCCGTGCCGGGTACCGTACGGATTCCACGGCGTGTATTACCAAGG
	DZ 193	G	A	A	A	G	A	TGGCCGCGCTGCCGTGCCGGGTACCGTACGGATTCCACGGCGTGTATTACCAAGG

Figure S2. Sequence analysis of the candidate gene *GP4* from 12 accessions with C-type and 12 accessions with A-type. * indicates synonymous SNP substitution.

Variation position	Allele	Genotype	INDICA	JAPONICA
1,971,215	Primary allele	G	27.00%	85.70%
	Secondary allele	T	72.50%	14.20%
1,971,303	Primary allele	T	99.70%	100.00%
	Secondary allele	A	0.30%	0.00%
1,971,593	Primary allele	G	99.30%	100.00%
	Secondary allele	A	0.40%	0.00%
1,971,671	Primary allele	TGGCCGCGCTGCCGTGCCGGGTGCTGTACGGATTCCACGGCGTGTTTATTACCAAGG	69.70%	13.00%
	Secondary allele	TGGCCGCGCTGCCGTGCCGGGTGCCGTACGGATTCCACGGCTTGTTTATTACCAAGG	0.90%	37.90%

Figure S3. Allele frequency of four functional polymorphic sites in *INDICA* and *JAPONICA*. Allele frequencies were obtained from RiceVarMap v2.0 (<http://ricevarmap.ncpgr.cn/>, accessed on 6 September 2024).

Table S1. List of 103 rice accessions used for GWAS.

NSFTV ID.	Accession name	Sub-population	2020	2021
NSFTV3	Ai-Chiao-Hong	<i>indica</i>		
NSFTV4	NSF-TV 4	<i>aus</i>		
NSFTV13	NSF-TV 13	<i>aus</i>		
NSFTV17	Binulawan	<i>indica</i>		
NSFTV21	Byakkoku Y 5006 Seln	<i>indica</i>		
NSFTV29	Chau	<i>indica</i>		
NSFTV30	Chiem Chanh	<i>indica</i>		
NSFTV33	Chuan 4	<i>aus</i>		
NSFTV34	NSF-TV 34	<i>indica</i>		NA
NSFTV43	Dee Geo Woo Gen	<i>indica</i>		
NSFTV44	Dhala Shaitta	<i>aus</i>		
NSFTV49	DV85	<i>aus</i>		NA
NSFTV57	NSF-TV 57	<i>indica</i>		
NSFTV58	Ghati Kamma Nangarhar	<i>aus</i>		NA
NSFTV71	IR 36	<i>indica</i>	NA	
NSFTV72	IR 8	<i>indica</i>		
NSFTV74	IRGA 409	<i>indica</i>		
NSFTV76	Jaya	<i>indica</i>		
NSFTV77	JC149	<i>indica</i>		
NSFTV78	Jhona 349	<i>aus</i>		
NSFTV85	Kasalath	<i>aus</i>		
NSFTV90	Kiang-Chou-Chiu	<i>indica</i>		
NSFTV102	Leung Pratew	<i>indica</i>		
NSFTV105	Mehr	<i>aus</i>		
NSFTV106	Ming Hui	<i>indica</i>		
NSFTV117	O-Luen-Cheung	<i>indica</i>		
NSFTV123	Pagaiyahan	<i>indica</i>		
NSFTV125	Pao-Tou-Hung	<i>indica</i>		
NSFTV126	Pappaku	<i>indica</i>		
NSFTV129	Peh-Kuh	<i>indica</i>		
NSFTV130	Peh-Kuh-Tsao-Tu	<i>indica</i>		
NSFTV132	Rathuwee	<i>indica</i>		
NSFTV136	RTS12	<i>indica</i>		
NSFTV137	RTS14	<i>indica</i>		
NSFTV142	Shai-Kuh	<i>indica</i>		
NSFTV152	T 1	<i>aus</i>		
NSFTV153	T26	<i>aus</i>		
NSFTV156	Taichung Native 1	<i>indica</i>		
NSFTV161	TeQing	<i>indica</i>		NA
NSFTV163	Taducan	<i>indica</i>		
NSFTV171	ZHE 733	<i>indica</i>		

NSFTV172	Zhenshan 2	<i>indica</i>	
NSFTV189	Criollo La Fria	<i>indica</i>	
NSFTV200	P 737	<i>aus</i>	NA
NSFTV203	Radin Ebos 33	<i>indica</i>	
NSFTV208	SLO 17	<i>indica</i>	
NSFTV209	Tchibanga	<i>indica</i>	
NSFTV222	Paraiba Chines Nova	<i>indica</i>	
NSFTV228	CA 902/B/2/1	<i>aus</i>	
NSFTV231	Hunan Early Dwarf No. 3	<i>indica</i>	
NSFTV234	Aijiaonante	<i>indica</i>	
NSFTV235	Sze Guen Zim	<i>indica</i>	
NSFTV241	ECIA76-S89-1	<i>indica</i>	
NSFTV252	Djimoron	<i>indica</i>	
NSFTV255	Pai Hok Glutinous	<i>indica</i>	
NSFTV261	Shim Balte	<i>aus</i>	
NSFTV276	Kaukau	<i>aus</i>	
NSFTV284	IR-44595	<i>indica</i>	
NSFTV299	SML 242	<i>indica</i>	
NSFTV304	519	<i>indica</i>	
NSFTV313	BR24	<i>indica</i>	
NSFTV315	Dawebyan	<i>indica</i>	
NSFTV316	DD 62	<i>aus</i>	
NSFTV317	DJ 123	<i>aus</i>	
NSFTV318	DJ 24	<i>aus</i>	
NSFTV319	DK 12	<i>aus</i>	
NSFTV320	DM 43	<i>aus</i>	NA
NSFTV321	DM 56	<i>aus</i>	
NSFTV323	DNJ 140	<i>aus</i>	NA
NSFTV325	EMATA A 16-34	<i>indica</i>	
NSFTV326	Ghorbhai	<i>aus</i>	
NSFTV327	Goria	<i>aus</i>	
NSFTV329	Kachilon	<i>aus</i>	NA
NSFTV330	Khao Pahk Maw	<i>aus</i>	
NSFTV336	Paung Malaung	<i>aus</i>	
NSFTV337	Sabharaj	<i>indica</i>	
NSFTV339	Yodanya	<i>indica</i>	
NSFTV341	Shirkati	<i>aus</i>	
NSFTV345	DZ 193	<i>aus</i>	
NSFTV346	Karkati 87	<i>aus</i>	
NSFTV348	China 1039	<i>indica</i>	
NSFTV349	Chang Ch'Sang Hsu Tao	<i>indica</i>	
NSFTV353	ARC 10376	<i>aus</i>	
NSFTV356	JC 117	<i>indica</i>	
NSFTV357	9524	<i>aus</i>	

NSFTV359	Surjamkuhi	<i>aus</i>	
NSFTV360	PTB 30	<i>aus</i>	
NSFTV369	Sathi	<i>aus</i>	
NSFTV370	Coarse	<i>aus</i>	
NSFTV371	Santhi Sufaid	<i>aus</i>	
NSFTV372	Sufaid	<i>aus</i>	NA
NSFTV385	Nira	<i>indica</i>	
NSFTV400	Yang Dao 6	<i>indica</i>	
NSFTV616	RT0034	<i>indica</i>	
NSFTV620	Jasmine85	<i>indica</i>	
NSFTV626	C101A51	<i>indica</i>	
NSFTV633	Jing 185-7	<i>indica</i>	NA
NSFTV634	Rondo (4484-1693)	<i>indica</i>	
NSFTV636	Sadu Cho	<i>indica</i>	NA
NSFTV642	Zhenshan 97B	<i>indica</i>	
NSFTV643	Minghui 63	<i>indica</i>	
NSFTV644	IR64	<i>indica</i>	NA
NSFTV651	Dular	<i>aus</i>	NA

NA indicates the phenotypic data is not available for that year.

Table S2. The lead SNP (Chr4-1,966,105) genotypes of all accessions.

NSFTV ID.	Accession name	Sub-population	Chr4-1,966,105
NSFTV3	Ai-Chiao-Hong	<i>indica</i>	C
NSFTV4	NSF-TV 4	<i>aus</i>	C
NSFTV13	NSF-TV 13	<i>aus</i>	C
NSFTV17	Binulawan	<i>indica</i>	C
NSFTV21	Byakkoku Y 5006 Seln	<i>indica</i>	C
NSFTV29	Chau	<i>indica</i>	C
NSFTV30	Chiem Chanh	<i>indica</i>	C
NSFTV33	Chuan 4	<i>aus</i>	A
NSFTV34	NSF-TV 34	<i>indica</i>	C
NSFTV43	Dee Geo Woo Gen	<i>indica</i>	C
NSFTV44	Dhala Shaitta	<i>aus</i>	A
NSFTV49	DV85	<i>aus</i>	N
NSFTV57	NSF-TV 57	<i>indica</i>	C
NSFTV58	Ghati Kamma Nangarhar	<i>aus</i>	C
NSFTV71	IR 36	<i>indica</i>	C
NSFTV72	IR 8	<i>indica</i>	C
NSFTV74	IRGA 409	<i>indica</i>	C
NSFTV76	Jaya	<i>indica</i>	C
NSFTV77	JC149	<i>indica</i>	C
NSFTV78	Jhona 349	<i>aus</i>	C
NSFTV85	Kasalath	<i>aus</i>	C
NSFTV90	Kiang-Chou-Chiu	<i>indica</i>	C
NSFTV102	Leung Pratew	<i>indica</i>	C
NSFTV105	Mehr	<i>aus</i>	A
NSFTV106	Ming Hui	<i>indica</i>	C
NSFTV117	O-Luen-Cheung	<i>indica</i>	C
NSFTV123	Pagaiyahan	<i>indica</i>	C
NSFTV125	Pao-Tou-Hung	<i>indica</i>	C
NSFTV126	Pappaku	<i>indica</i>	C
NSFTV129	Peh-Kuh	<i>indica</i>	C
NSFTV130	Peh-Kuh-Tsao-Tu	<i>indica</i>	C
NSFTV132	Rathuwee	<i>indica</i>	C
NSFTV136	RTS12	<i>indica</i>	C
NSFTV137	RTS14	<i>indica</i>	C
NSFTV142	Shai-Kuh	<i>indica</i>	C
NSFTV152	T 1	<i>aus</i>	A
NSFTV153	T26	<i>aus</i>	A
NSFTV156	Taichung Native 1	<i>indica</i>	C
NSFTV161	TeQing	<i>indica</i>	N
NSFTV163	Taducan	<i>indica</i>	C

NSFTV171	ZHE 733	<i>indica</i>	C
NSFTV172	Zhenshan 2	<i>indica</i>	C
NSFTV189	Criollo La Fria	<i>indica</i>	C
NSFTV200	P 737	<i>aus</i>	N
NSFTV203	Radin Ebos 33	<i>indica</i>	C
NSFTV208	SLO 17	<i>indica</i>	C
NSFTV209	Tchibanga	<i>indica</i>	C
NSFTV222	Paraiba Chines Nova	<i>indica</i>	C
NSFTV228	CA 902/B/2/1	<i>aus</i>	C
NSFTV231	Hunan Early Dwarf No. 3	<i>indica</i>	C
NSFTV234	Aijiaonante	<i>indica</i>	C
NSFTV235	Sze Guen Zim	<i>indica</i>	C
NSFTV241	ECIA76-S89-1	<i>indica</i>	C
NSFTV252	Djimoron	<i>indica</i>	C
NSFTV255	Pai Hok Glutinous	<i>indica</i>	C
NSFTV261	Shim Balte	<i>aus</i>	C
NSFTV276	Kaukau	<i>aus</i>	A
NSFTV284	IR-44595	<i>indica</i>	C
NSFTV299	SML 242	<i>indica</i>	C
NSFTV304	519	<i>indica</i>	C
NSFTV313	BR24	<i>indica</i>	C
NSFTV315	Dawebyan	<i>indica</i>	C
NSFTV316	DD 62	<i>aus</i>	A
NSFTV317	DJ 123	<i>aus</i>	A
NSFTV318	DJ 24	<i>aus</i>	A
NSFTV319	DK 12	<i>aus</i>	A
NSFTV320	DM 43	<i>aus</i>	C
NSFTV321	DM 56	<i>aus</i>	C
NSFTV323	DNJ 140	<i>aus</i>	C
NSFTV325	EMATA A 16-34	<i>indica</i>	C
NSFTV326	Ghorbhai	<i>aus</i>	A
NSFTV327	Goria	<i>aus</i>	C
NSFTV329	Kachilon	<i>aus</i>	C
NSFTV330	Khao Pahk Maw	<i>aus</i>	A
NSFTV336	Paung Malaung	<i>aus</i>	A
NSFTV337	Sabharaj	<i>indica</i>	C
NSFTV339	Yodanya	<i>indica</i>	C
NSFTV341	Shirkati	<i>aus</i>	C
NSFTV345	DZ 193	<i>aus</i>	A
NSFTV346	Karkati 87	<i>aus</i>	C
NSFTV348	China 1039	<i>indica</i>	C
NSFTV349	Chang Ch'Sang Hsu Tao	<i>indica</i>	C
NSFTV353	ARC 10376	<i>aus</i>	A
NSFTV356	JC 117	<i>indica</i>	C

NSFTV357	9524	<i>aus</i>	C
NSFTV359	Surjamkuhi	<i>aus</i>	A
NSFTV360	PTB 30	<i>aus</i>	A
NSFTV369	Sathi	<i>aus</i>	C
NSFTV370	Coarse	<i>aus</i>	C
NSFTV371	Santhi Sufaid	<i>aus</i>	C
NSFTV372	Sufaid	<i>aus</i>	C
NSFTV385	Nira	<i>indica</i>	C
NSFTV400	Yang Dao 6	<i>indica</i>	C
NSFTV616	RT0034	<i>indica</i>	C
NSFTV620	Jasmine85	<i>indica</i>	C
NSFTV626	C101A51	<i>indica</i>	C
NSFTV633	Jing 185-7	<i>indica</i>	C
NSFTV634	Rondo (4484-1693)	<i>indica</i>	C
NSFTV636	Sadu Cho	<i>indica</i>	C
NSFTV642	Zhenshan 97B	<i>indica</i>	C
NSFTV643	Minghui 63	<i>indica</i>	C
NSFTV644	IR64	<i>indica</i>	C
NSFTV651	Dular	<i>aus</i>	C

NA indicates missing data.