

# Genome sequences of sixty *Magnaporthe oryzae* isolates from multiple host plant species

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The blast fungus *Magnaporthe oryzae* (syn. *Pyricularia oryzae*) is able to cause disease on more than 50 grass species, including important cereal crops such as rice, wheat and finger millet (Couch and Kohn 2002; Zhang et al. 2016). Understanding the evolutionary relationships between host-limited forms of the blast fungus is critical to being able to devise effective control strategies for the devastating diseases that they cause. For example, identifying host-specificity determinants may be valuable in identifying cognate disease resistance loci that could be deployed between different host species (Sweigard et al. 1995). This strategy has the capacity to lead to more durable disease control (Kawashima et al. 2016). Here, we present whole genome sequence information for a set of 60 *Magnaporthe oryzae* isolates collected between 1964 and 2017 from 14 countries and 5 different host plant species. Host grass species include rice (*Oryza sativa*), barley (*Hordeum vulgare*) wheat (*Triticum aestivum*), torpedo grass (*Panicum repens*) and Southern cutgrass (*Leersia hexandra*).

In addition to the distinct host-limited forms of *M. oryzae*, we also report genome sequence information for twenty-six rice-infecting isolates of *M. oryzae*. These rice blast isolates were collected from nine sub-Saharan African countries with the aim of understanding the population structure of rice blast in the region (Mutiga et al. 2017). Twenty three isolates were collected from Bangladesh during the 2016 and 2017 wheat blast outbreak (Islam et al. 2016). An additional 11 isolates were collected from China, USA, Puerto Rico, Egypt and Thailand in different years (Talbot et al. 1993). The genomes were sequenced using Illumina Genome Analyzer II, HiSeq 2000 and HiSeq 2500 sequencing to produce paired-end reads. De novo assembly was carried out using Velvet and Spades (<https://www.ebi.ac.uk/~zerbino/velvet/> <http://bioinf.spbau.ru/en/spades>) (Bankevich et al. 2012; Zerbino and Birney 2008).

We provide genome assemblies of 60 *M. oryzae* isolates sequenced using Illumina paired-end read sequencing and assembled as shown in Table 1. Basic information is provided regarding the origin of each fungal isolate, the quality of data generated, and links to the relevant information deposited in ENA. The genome assemblies made range in length from 38.1 Mbp to 46.7 Mbp, as shown in Table 2. We also provide information regarding N25, N50 and N75 values, as well as the Genbank submission information for easy retrieval. Although the quality of sequencing and assembly varies depending on sequencing platform used and year of sequencing, we believe that all of the data will be of utility as an open science resource for analysis.

The data from this project is provided as part of the OpenRiceBlast (<http://openriceblast.org/>) and OpenWheatBlast (<http://openwheatblast.net/>) communities on Zenodo. We will report our own analysis of this information in due course, but we wish to make the raw data available to the wider research community as soon as possible. The raw reads and assemblies are available on European Nucleotide Archive website.

Please feel free to contact the authors with queries and analysis, or to establish collaborative approaches to utilising the information.

## **Materials and methods**

RNA-free genomic DNA was isolated from 8 to 10-day old mycelia grown on complete media by use of Hexadecyltrimethylammonium Bromide (CTAB). The quality of genomic DNA was then assessed using a NanoDrop spectrophotometer (Thermo Scientific) and Qubit BR assay (Thermo Fischer, NY, USA). NEXTflex™ Rapid DNA-seq Library Prep Kit was used to prepare and index libraries before sequencing on HiSeq 2500 (Illumina), with two lanes per sample. The quality of sequencing reads was first assessed using the FastQC toolkit (<http://www.bioinformatics.bbsrc.ac.uk/projects/fastqc/>). Adaptor sequences were trimmed from raw reads and low-quality reads removed using the fastq-mcf before aligning to the reference genome (70-15) (Dean et al. 2005) using BWA (Burrow Wheeler Aligner) <https://github.com/lh3/bwa> (Li and Durbin 2009)

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**Table 1. *M. oryzae* isolates sequenced in this study and summary statistics from Illumina sequencing**

Isolate	Host	Source	Year collected	Run type	Base caller	# Reads	Flow cell ID	ENA accession
76_3	<i>Oryza sativa</i>	China	1990	Paired	bcl2fastq	23540232	H87AHADXX	ERS2571862 (SAMEA4751761)
82_0835	<i>Oryza sativa</i>	China	1990	Paired	bcl2fastq	34303808	H87AHADXX	ERS2571863 (SAMEA4751762)
90_4_1	<i>Oryza sativa</i>	China	1993	Paired	bcl2fastq	30353727	H87AHADXX	ERS2571863 (SAMEA4751762)
BF17	<i>Oryza sativa</i>	Niéna Dionkéle, Burkina Faso	2013	Paired	bcl2fastq	20450206	C7T2RACXX	ERS2573612 (SAMEA4753513)
BF32	<i>Oryza sativa</i>	Banfora, Burkina Faso	2013	Paired	bcl2fastq	26610768	C7T2RACXX	ERS2573613 (SAMEA4753514)
BF48	<i>Oryza sativa</i>	Banfora, Burkina Faso	2013	Paired	bcl2fastq	24061747	C7T2RACXX	ERS2573614 (SAMEA4753515)
BF5	<i>Oryza sativa</i>	Sinkoura, Burkina Faso	2013	Paired	bcl2fastq	27253263	C7T2RACXX	ERS2573611 (SAMEA4753512)
BN0293	<i>Oryza sativa</i>	Lokossa, Benin	2011	Paired	bcl2fastq	21460297	C7T2RACXX	ERS2573615 (SAMEA4753516)
BTAR_A1	<i>Leersia hexandra</i>	Gazipur City, Bangladesh	2016	Paired	bcl2fastq	49526949	HH7GHBCXY	ERS1990358 (SAMEA104365380)
BTBa_2	<i>Hordeum vulgare</i>	Gazipur City, Bangladesh	2016	Paired	bcl2fastq	50503542	CB97UANXX	ERS1849825 (SAMEA104190807)
BTBaB1	<i>Hordeum vulgare</i>	Gazipur City, Bangladesh	2016	Paired	bcl2fastq	41681521	C9WFLANXX	ERS1849824 (SAMEA104190806)
BTGP-6(e)	<i>Triticum aestivum</i>	Gangni, Meherpur, Bangladesh	2017	Paired	bcl2fastq	55697509	C9WFLANXX	ERS1849826 (SAMEA104190808)
BTGP-6(f)	<i>Triticum aestivum</i>	Gangni, Meherpur, Bangladesh	2017	Paired	bcl2fastq	48396283	C9WFLANXX	ERS1849828 (SAMEA104190810)
BTGP-6(g)	<i>Triticum aestivum</i>	Gangni, Meherpur, Bangladesh	2017	Paired	bcl2fastq	75791772	C9WFLANXX	ERS1849829 (SAMEA104190811)
BTGP-6(h)	<i>Triticum aestivum</i>	Gangni, Meherpur, Bangladesh	2017	Paired	bcl2fastq	82006131	C9WFLANXX	ERS1849830 (SAMEA104190812)
BTGP1_b	<i>Triticum aestivum</i>	Gangni, Meherpur, Bangladesh	2017	Paired	bcl2fastq	66467086	C9WFLANXX	ERS1849827 (SAMEA104190809)
BTJP_4_1	<i>Triticum aestivum</i>	Jhenaidah, Bangladesh	2016	Paired	bcl2fastq	48584800	CB97UANXX	ERS1849831 (SAMEA104190813)
BTJP_4_15	<i>Triticum aestivum</i>	Jhenaidah, Bangladesh	2016	Paired	bcl2fastq	59278260	HH7GHBCXY	ERS1990359 (SAMEA104365381)
BTJP_4_2	<i>Triticum aestivum</i>	Jhenaidah, Bangladesh	2016	Paired	bcl2fastq	41114442	HH7GHBCXY	ERS1990360 (SAMEA104365382)
BTJP_4_9	<i>Triticum aestivum</i>	Jhenaidah, Bangladesh	2016	Paired	bcl2fastq	85885683	HH7GHBCXY	ERS1990361 (SAMEA104365383)
BTJP4_11	<i>Triticum aestivum</i>	Jhenaidah, Bangladesh	2016	Paired	bcl2fastq	62184751	CB97UANXX	ERS1849835 (SAMEA104190817)
BTJP4_12	<i>Triticum aestivum</i>	Jhenaidah, Bangladesh	2016	Paired	bcl2fastq	90449542	CB97UANXX	ERS1849836 (SAMEA104190818)
BTJP4_16	<i>Triticum aestivum</i>	Jhenaidah, Bangladesh	2016	Paired	bcl2fastq	81189018	CB97UANXX	ERS1849837 (SAMEA104190819)
BTJP4_18	<i>Triticum aestivum</i>	Jhenaidah, Bangladesh	2016	Paired	bcl2fastq	53670999	C9WFLANXX	ERS1849838 (SAMEA104190820)
BTJP4_3	<i>Triticum aestivum</i>	Jhenaidah, Bangladesh	2016	Paired	bcl2fastq	79672770	CB97UANXX	ERS1849832 (SAMEA104190814)
BTJP4_5	<i>Triticum aestivum</i>	Jhenaidah, Bangladesh	2016	Paired	bcl2fastq	44719291	C9WFLANXX	ERS1849833 (SAMEA104190815)
BTJP4_6	<i>Triticum aestivum</i>	Jhenaidah, Bangladesh	2016	Paired	bcl2fastq	60785721	C9WFLANXX	ERS1849834 (SAMEA104190816)
BTMP_S_13_2	<i>Triticum aestivum</i>	Meherpur, Bangladesh	2016	Paired	bcl2fastq	111218958	CB97UANXX	ERS1849840 (SAMEA104190822)
BTMP_S13_1	<i>Triticum aestivum</i>	Meherpur, Bangladesh	2016	Paired	bcl2fastq	43906108	C9WFLANXX	ERS1849839 (SAMEA104190821)
BTTTrp_5	<i>Panicum repens</i>	Gazipur City, Bangladesh	2016	Paired	bcl2fastq	70717029	CB97UANXX	ERS1849841 (SAMEA104190823)
BTTTrp_6	<i>Panicum repens</i>	Gazipur City, Bangladesh	2016	Paired	bcl2fastq	98874992	CB97UANXX	ERS1849842 (SAMEA104190824)
EG308	<i>Oryza sativa</i>	Egypt	1999	Paired	bcl2fastq	25114675	HA3RNADXX	ERS2573604 (SAMEA4753505)
Glhn3	<i>Oryza sativa</i>	Hangzhou, China	1990	Paired	bcl2fastq	23331437	H87AHADXX	ERS2571868 (SAMEA4751767)
Glhn4	<i>Oryza sativa</i>	Hangzhou, China	1990	Paired	bcl2fastq	26344291	H87AHADXX	ERS2571869 (SAMEA4751768)

JUM1	<i>Oryza sativa</i>	USA	Unknown	Paired	bcl2fastq	21446378	C7T2RACXX	ERS2573616 (SAMEA4753517)
KE002	<i>Oryza sativa</i>	Mwea, Kenya	2013	Paired	bcl2fastq	28987421	HA3RNADXX	ERS2573604 (SAMEA4753505)
KE016	<i>Oryza sativa</i>	Mwea, Kenya	2013	Paired	bcl2fastq	27005862	HA3RNADXX	ERS2573606 (SAMEA4753507)
KE017	<i>Oryza sativa</i>	Mwea, Kenya	2013	Paired	bcl2fastq	23611698	HA3RNADXX	ERS2573607 (SAMEA4753508)
KE019	<i>Oryza sativa</i>	Mwea, Kenya	2013	Paired	bcl2fastq	16336926	HA3RNADXX	ERS2573608 (SAMEA4753509)
KE021	<i>Oryza sativa</i>	Mwea, Kenya	2013	Paired	bcl2fastq	27908985	HA3RNADXX	ERS2573609 (SAMEA4753510)
KE029	<i>Oryza sativa</i>	Mwea, Kenya	2013	Paired	bcl2fastq	28640331	HA3RNADXX	ERS2573610 (SAMEA4753511)
KE041	<i>Oryza sativa</i>	Wanguru, Central Kenya	2013	Paired	bcl2fastq	26915830	C7T2RACXX	ERS2573617 (SAMEA4753518)
KE210	<i>Oryza sativa</i>	Ahero, Kenya	2014	Paired	bcl2fastq	13379917	C7T2RACXX	ERS2573618 (SAMEA4753519)
KE255	<i>Oryza sativa</i>	Ahero, Kenya	2014	Paired	bcl2fastq	18488353	C7T2RACXX	ERS2573619 (SAMEA4753520)
KE332	<i>Oryza sativa</i>	Homabay, Kenya	2014	Paired	bcl2fastq	63970018	C9WFLANXX	ERS2573627 (SAMEA4753528)
KE415	<i>Oryza sativa</i>	Lungalunga, Kenya	2014	Paired	bcl2fastq	30091369	CB979ANXX	ERS2573628 (SAMEA4753529)
KE443	<i>Oryza sativa</i>	Kikoneni, Kenya	2014	Paired	bcl2fastq	74678178	CB979ANXX	ERS2573629 (SAMEA4753530)
KE473	<i>Oryza sativa</i>	Lungalunga, Kenya	2014	Paired	bcl2fastq	72817488	C9WFLANXX	ERS2573630 (SAMEA4753531)
KE491	<i>Oryza sativa</i>	Lungalunga, Kenya	2014	Paired	bcl2fastq	45844225	CB979ANXX	ERS2573631 (SAMEA4753532)
NG0110	<i>Oryza sativa</i>	Ibadan, Nigeria	2010	Paired	bcl2fastq	22398613	C7T2RACXX	ERS2573621 (SAMEA4753522)
NG0135	<i>Oryza sativa</i>	Ibadan, Nigeria	2009	Paired	bcl2fastq	18584392	C7T2RACXX	ERS2573622 (SAMEA4753523)
NG0153	<i>Oryza sativa</i>	Ibadan, Nigeria	2009	Paired	bcl2fastq	21398312	C7T2RACXX	ERS2573623 (SAMEA4753524)
NGO104	<i>Oryza sativa</i>	Ibadan, Nigeria	2010	Paired	bcl2fastq	23958019	C7T2RACXX	ERS2573620 (SAMEA4753521)
TG004	<i>Oryza sativa</i>	Elavayo, Togo	2012	Paired	bcl2fastq	21348265	C7T2RACXX	ERS2573624 (SAMEA4753525)
TH3	<i>Oryza sativa</i>	Thailand	Unknown	Paired	CASSAVA	46233676	Unknown	ERS2571875 (SAMEA4751774)
TZ090	<i>Oryza sativa</i>	Ifakara, Tanzania	2013	Paired	bcl2fastq	29085784	C7T2RACXX	ERS2573625 (SAMEA4753526)
UG08	<i>Oryza sativa</i>	Namulonge, Uganda	2013	Paired	bcl2fastq	37521198	C7T2RACXX	ERS2573626 (SAMEA4753527)
V0104	<i>Oryza sativa</i>	Puerto Rico	1987	Paired	bcl2fastq	23991041	H87AHADXX	ERS2571876 (SAMEA4751775)
V0108	<i>Oryza sativa</i>	Louisiana, USA	1964	Paired	bcl2fastq	26441533	H87AHADXX	ERS2571877 (SAMEA4751776)
V0113	<i>Oryza sativa</i>	Texas, USA	1967	Paired	bcl2fastq	28088526	H87AHADXX	ERS2571878 (SAMEA4751777)

**Table 2. Genome assembly statistics of isolates used in this study**

Isolate	Host	Assembler	# contigs	Assembly length (bp)	N25 (bp)	N50 (bp)	N75 (bp)	Min length	Max length	Mean length	GeneBank Accession
76_3	<i>Oryza sativa</i>	Velvet	3034	38352907	388668	159298	58308	149	774233	12641.02	GCA_905081835
82_0835	<i>Oryza sativa</i>	Velvet	4971	40074503	311815	136309	44433	149	871964	8061.63	GCA_905105065
90_4_1	<i>Oryza sativa</i>	Velvet	4812	39527383	383552	151648	44913	149	945896	8214.28	GCA_905105115
BF17	<i>Oryza sativa</i>	Spades	4455	39725824	291577	138447	44439	149	1043654	8917.13	GCA_905105105
BF32	<i>Oryza sativa</i>	Spades	5341	40189893	293649	120312	42129	149	701123	7524.79	GCA_905105085
BF48	<i>Oryza sativa</i>	Spades	4592	40015456	291421	144015	42880	149	742596	8714.17	GCA_905105095
BF5	<i>Oryza sativa</i>	Spades	6185	40969151	251671	122962	45418	149	661385	6623.95	GCA_905105125
BN0293	<i>Oryza sativa</i>	Spades	6335	40010648	286166	124287	41287	149	980883	6315.81	GCA_905104965
BTAR_A1	<i>Leersia hexandra</i>	Spades	3260	38140674	178111	93389	33262	122	514365	11699.59	GCA_905109135
BTBa_2	<i>Hordeum vulgare</i>	Spades	2151	43755255	159763	91759	47076	122	507668	20341.82	GCA_905109125
BTBab1	<i>Hordeum vulgare</i>	Spades	1125	43399635	171227	101720	53860	122	392327	38577.45	GCA_905109115
BTGP-6(e)	<i>Triticum aestivum</i>	Spades	1548	43,622,001	209737	115705	61320	122	553387	28179.59	GCA_905114805
BTGP-6(f)	<i>Triticum aestivum</i>	Spades	1099	43,418,197	169642	104430	55137	122	400249	39507	GCA_905114815
BTGP-6(g)	<i>Triticum aestivum</i>	Spades	1725	43643196	172440	98580	54673	122	830838	25300.4	GCA_905109825
BTGP-6(h)	<i>Triticum aestivum</i>	Spades	1738	43657328	180756	105122	55075	122	366390	25119.29	GCA_905114825
BTGP1_b	<i>Triticum aestivum</i>	Spades	1744	43,645,146	180328	107077	53970	122	549508	25025.89	GCA_905109085
BTJP_4_1	<i>Triticum aestivum</i>	Spades	1100	43392441	193178	109624	54305	122	503559	39447.67	GCA_905125175
BTJP_4_15	<i>Triticum aestivum</i>	Spades	1772	43574924	257781	153255	70435	122	986469	24590.81	GCA_905109845
BTJP_4_2	<i>Triticum aestivum</i>	Spades	969	43194179	248231	134160	65085	122	642096	44576.04	GCA_905109755
BTJP_4_9	<i>Triticum aestivum</i>	Spades	1684	43511044	217295	140435	66650	122	520247	25837.91	GCA_905109915
BTJP4_11	<i>Triticum aestivum</i>	Spades	1876	43,630,244	153156	91549	45360	122	338642	23257.06	GCA_905109105
BTJP4_12	<i>Triticum aestivum</i>	Spades	1741	43,632,231	206390	110022	59306	122	521481	25061.59	GCA_905109095
BTJP4_16	<i>Triticum aestivum</i>	Spades	1799	43,632,753	160085	95064	49325	122	504525	24253.89	GCA_905109245
BTJP4_18	<i>Triticum aestivum</i>	Spades	1156	43,394,295	171220	98888	49596	122	514505	37538.32	GCA_905109485
BTJP4_3	<i>Triticum aestivum</i>	Spades	1943	43,673,126	154352	92411	48076	122	486506	22477.16	GCA_905109785
BTJP4_5	<i>Triticum aestivum</i>	Spades	1244	43,437,982	155497	90380	46589	122	332673	34917.99	GCA_905186785
BTJP4_6	<i>Triticum aestivum</i>	Spades	1843	43645672	157266	90777	48649	122	424240	23681.86	GCA_905109745
BTMP_S_13_2	<i>Triticum aestivum</i>	Spades	1852	43677391	182662	108438	58334	122	440740	23583.9	GCA_905186795
BTMP_S13_1	<i>Triticum aestivum</i>	Spades	1093	43,268,406	166229	99038	50725	122	505850	39586.83	GCA_905109815
BTTTrp_5	<i>Panicum repens</i>	Spades	1692	46707658	269995	114140	46058	122	1429494	27605	GCA_905109925
BTTTrp_6	<i>Panicum repens</i>	Spades	2979	41501021	189758	109057	42843	122	849140	13931.19	GCA_905109775
EG308	<i>Oryza sativa</i>	Spades	5528	41564590	340093	149180	40284	229	756898	7518.92	GCA_905109905
Glhn3	<i>Oryza sativa</i>	Velvet	4000	39394696	309694	134271	45343	149	764316	9848.25	GCA_905109765

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Glhn4	Oryza sativa	Velvet	3877	39521716	331782	134201	48014	149	764117	10193.83	GCA_905109895
JUM1	Oryza sativa	Spades	4992	40503273	242767	127476	42509	149	597604	8113.64	GCA_905109865
KE002	Oryza sativa	Spades	5101	40252061	305925	147435	41525	237	694455	7891.01	GCA_905125185
KE016	Oryza sativa	Spades	4818	40270040	358372	156802	44789	229	868332	8358.25	GCA_905109875
KE017	Oryza sativa	Spades	9348	41104100	305216	141652	33239	229	713476	4397.1	GCA_905109835
KE019	Oryza sativa	Spades	3334	39371043	364367	176600	48024	197	948236	11808.95	GCA_905109805
KE021	Oryza sativa	Spades	4437	40076482	340998	152792	45116	229	1032103	9032.34	GCA_905109885
KE029	Oryza sativa	Spades	7752	41039609	309585	154544	39782	229	677851	5294.07	GCA_905114085
KE041	Oryza sativa	Spades	3793	39008374	305817	146883	46067	149	908749	10284.31	GCA_905114095
KE210	Oryza sativa	Spades	9941	38854174	30811	15865	6606	149	99136	3908.48	GCA_905114105
KE255	Oryza sativa	Spades	5886	39832145	274928	119152	38862	149	531872	6767.27	GCA_905114645
KE332	Oryza sativa	Spades	6268	41002515	65710	35062	14070	122	220787	6541.57	GCA_905114655
KE415	Oryza sativa	Spades	3668	39452515	61608	33912	15725	122	213568	10755.59	GCA_905114665
KE443	Oryza sativa	Spades	6077	40885170	68621	36419	15840	122	249604	6727.85	GCA_905114675
KE473	Oryza sativa	Spades	5858	40617765	65803	37274	15582	122	246989	6933.48	GCA_905114695
KE491	Oryza sativa	Spades	3198	40053702	62335	34509	17263	122	186391	12521.41	GCA_905114685
NG0110	Oryza sativa	Spades	5080	39600383	231761	115527	36355	149	880941	7795.35	GCA_905114715
NG0135	Oryza sativa	Spades	5338	39852204	246152	109842	38149	149	538274	7465.76	GCA_905114725
NG0153	Oryza sativa	Spades	5339	39800748	308310	130820	43803	149	743903	7454.72	GCA_905114735
NGO104	Oryza sativa	Spades	4717	38946046	283476	128841	43771	149	659430	8256.53	GCA_905114705
TG004	Oryza sativa	Spades	5349	39965636	233666	125683	40017	149	907211	7471.61	GCA_905114755
TH3	Oryza sativa	Velvet	11989	37300286	44568	22628	9912	49	172616	3111.16	GCA_905114745
TZ090	Oryza sativa	Spades	3923	38952040	282899	127695	44087	149	675452	9929.15	GCA_905114765
UG08	Oryza sativa	Spades	5090	39183782	305726	122477	46462	149	1076399	7698.19	GCA_905114775
V0104	Oryza sativa	spades	4509	40346614	347703	126352	40724	149	702108	8841.57	GCA_905114785
V0108	Oryza sativa	Velvet	3984	39904286	343704	153228	47404	149	705967	10016.1	GCA_905232145
V0113	Oryza sativa	Velvet	3607	39758654	364106	151818	45897	149	1171465	11022.6	GCA_905114795

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