



Rice authenticity testing

DNA fingerprinting and genetic clustering analysis

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Testing for Life

Price differences between rice varieties

Weekly

Long Grain White Rice

Swarna 5% Broken	LRCDB00	364.00
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Basmati Rice

1509 Parboiled Basmati 2% (FOB FCL)	LRCGP00	750.00
1509 Steam Basmati 2% (FOB FCL)	LRCGS00	829.00
1121 Steam Basmati 2% (FOB FCL)	LRCHS00	1011.00
1121 Parboiled Milled Basmati	LRCNB00	902.00

2% (FOB FCL)

Note: Weekly prices were assessed on 19-Sep.

Vietnam - Long Grain Rice

5% Broken	LRBAB00	414.00
25% Broken	LRBDE00	394.00
100% Broken	LRBEC00	326.00
Fragrant 5% Broken	LRBFA00	514.00
OM 5451 5% Broken	LRBAA00	489.00

Platts Thailand Rice Price Assessments, Sep 23 (

Symbol Price

Daily

Long Grain Rice

100% Grade B	LRAAC00	360.00
5% Broken	LRABB00	350.00
25% Broken	LRAEE00	335.00
A1 Super 100% Broken	LRAFC00	324.00
PB 100% STX	LRAGC00	362.00
Hom Mali 100% Grade B	LRAKA00	1110.00

Weekly

Long Grain Parboiled Rice

Parboiled Milled 5% STX	LRAIB00	360.00
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Long Grain Fragrant Rice

Hom Mali A1 Super 100% Broken (FOB FCL)	LRALA00	375.00
Pathumthani Fragrant 100% Grade B (FOB FCL)	LRAMC00	551.00

Source: Platts Rice Assessment,
S&P Global

REGULATION (EC) No 178/2002 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 28 January 2002

laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety

Article 8

Protection of consumers' interests

1. Food law shall aim at the protection of the interests of consumers and shall provide a basis for consumers to make informed choices in relation to the foods they consume. It shall aim at the prevention of:

- (a) fraudulent or deceptive practices;
- (b) the adulteration of food; and
- (c) any other practices which may mislead the consumer.

EU protection of geographical indication and designation of origin



COMMISSION DELEGATED REGULATION (EU) 2023/2835

Article 2

Specific rules for imports of Basmati rice

1. This Section shall apply to husked Basmati rice falling within CN codes 1006 varieties:

- (a) Basmati 217;
- (b) Basmati 370;
- (c) Basmati 386;
- (d) Kernel (Basmati);
- (e) Pusa Basmati;
- (f) Ranbir Basmati;
- (g) Super Basmati;
- (h) Taraori Basmati (HBC-19);
- (i) Type-3 (Dehradun).

EU-Viet Nam Trade Agreement and Investment Protection Agreement

Four arrested in Basmati rice fraud investigation



PRESS RELEASE

Date: 07 August 2025

Four arrested in basmati rice fraud investigation

An investigation by the Food Standards Agency National Food Crime Unit (NFCU) into basmati rice fraud has **resulted in four arrests**¹. Large quantities of 10kg and 20kg bags of mixed rice in counterfeit premium brand basmati packaging were seized as part of the operation.

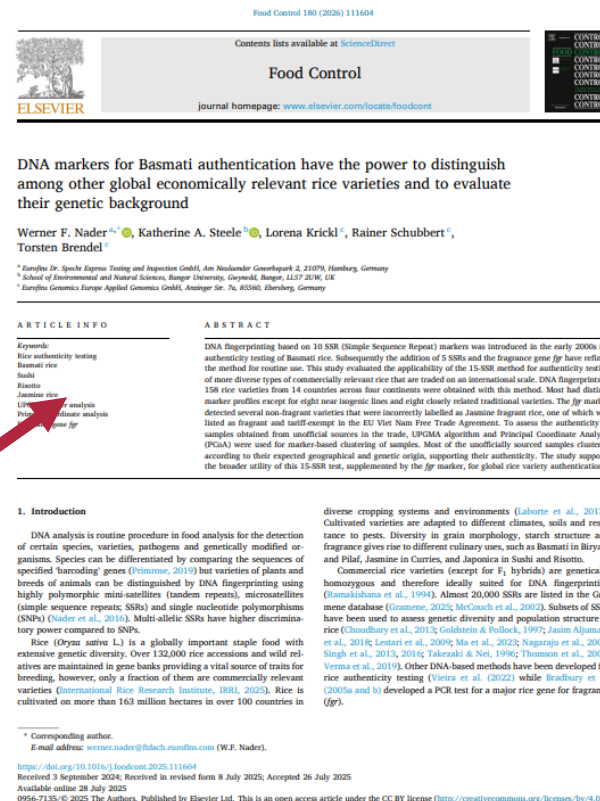
The UK has strict quality and authenticity requirements for basmati rice, set out in the 'Basmati Code of Practice', a set of legally enforced standards developed jointly by the Food Standards Agency and The Rice Association, the trade body representing the UK rice sector.

The Rice Association head of technical and regulatory affairs, Joe Brennan, said:

"It is good to see continued **active official enforcement of the Basmati Code of Practice**, which alongside regular industry surveys ensure that when UK consumers buy basmati rice they are getting an authentic product."

The code sets out the physical and aroma quality requirements of basmati rice and specifies the varieties that can be considered basmati, which is **verified with DNA authenticity testing**² by accredited laboratories. Basmati rice must be grown in India and Pakistan.

A condition of The Rice Association membership is to uphold industry standards, such as adherence to the Basmati Code of Practice. This requirement is taken seriously and consumer enquiries are investigated.



Eurofins DNA fingerprinting to enforce the European Code of Practice for Basmati rice



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The DNA fingerprint in food forensics: the Basmati rice case

KEYWORDS: Microsatellites, SSRs (simple sequence repeats), food fraud, Code of Practice, fragrance gene for, Basmati NJPlot dendrogram, analytical technologies.

ABSTRACT

Due to its exceptional aroma and cooking characteristics Basmati rice is one of the most popular rice specialties in the EU and the Middle East and is attracting a premium price. In the EU the strict authenticity definitions by the UK Code of Practice on Basmati Rice (CoP) of 2005 contributed significantly to improve the quality of this product and thereby its success on the market. Fifteen varieties were defined as authentic and a DNA fingerprinting method was determined for authenticity testing. Twenty six new varieties had been released since then by India and Pakistan as Basmati and had to be included in the revised CoP of 2017. This study reports the analysis of the DNA fingerprints of these cultivars from reference materials from official sources to enable the application of the CoP. Results not only allow the enforcement of the revised CoP, but provide further insights into the genetic relationships between the varieties and their descent from common ancestors. The Basmati cultivars of major economic importance can be grouped in four types due to their close relationship: Basmati 370, Ketan/Carson, Super Basmati and Pusa Basmati 1. The genotype Ig1 is supposedly the major cause of the Basmati aroma and missing in all of the new varieties. Because it is not the only functional polymorphism associated with fragrance of rice the content of aroma in these new varieties should be studied and further requirements should be defined including the organoleptic characteristics of Basmati.

INTRODUCTION

Due to recent food scandals like melamine in dairy products and horse meat in beef products the topic food fraud is receiving increasing attention. Innovations in laboratory analysis provide tools to detect adulterations and particularly DNA analysis is gaining increasing importance. Two principal methods in DNA analysis for food control can be distinguished (1, 2): (a) DNA barcoding to identify species of plants, animals and microorganisms like horse meat in beef products and (b) DNA fingerprinting to differentiate animal breeds and plant varieties, like for the detection of cheap long grain rice mixed into high value Basmati (3). DNA fingerprinting is based on allelic differences in hypervariable sequences. These are for example microsatellites (also called simple sequence repeats, SSRs, or short tandem repeats, STRs) and single nucleotide polymorphisms, SNPs. In fingerprinting of the second and third generation, respectively, it was first used for the identification of human individuals and has revolutionized forensics and the combat against crime. Basmati authenticity testing is a prominent example for its application in food forensics.

During the last decades Basmati became the favourite rice in the UK partly due to the large population originating from the Indian subcontinent (1). But adulterations with common long grain rice were frequently observed, which cost less than half the price of Basmati.

Therefore the British Retail Consortium BRC, Rice Association and the British Rice Millers Association issued in 2005 their Code of Practice on Basmati Rice and defined 15 rice varieties as authentic (4). Cultivation is geographically limited to 7 States in Northern India and the Punjab in Pakistan. The CoP defines in its article 4.1 DNA fingerprinting as the standard method to differentiate authentic Basmati from non-Basmati adulterants. Developed by Bligh (5) in 2000 the method has proven its reliability and robustness in practice and in numerous inter-laboratory ring trials and proficiency tests. The CoP has significantly improved the Basmati quality on the EU market. Whereas 13 out of 54 Basmati products were found adulterated in various consumer tests from 2004 to 2010 in Germany and France (6, 7, 8), in two recent German studies (9, 10) only one out of 36 products was not compliant with the CoP.

Since 2005 26 new Basmati varieties were notified in India and Pakistan and many of these are now cultivated on large commercial scale. Consequently the CoP had to be revised in 2017 and now includes all 41 cultivars released as Basmati in the countries of origin (4). In forensics criminals can be only identify based on the DNA traces left behind at the site of crime. If their DNA fingerprints are included in the police data base. Similarly rice varieties can be only identify if their DNA fingerprint is known. Therefore also the DNA fingerprinting method originally defined by the UK Food Standards Agency (FSA) had to be adapted and the Rice Association provided reference materials of all new varieties from official sources to our laboratory to determine the DNA fingerprints. This report reveals the results of this study, which shows Basmati authenticity testing under the new CoP and provides further information about the breeding history of Basmati varieties and their descent from traditional ancestors.

RESULTS AND DISCUSSION

The UK Code of Practice and Basmati authenticity definition in the EU Table 1 lists the 41 Basmati varieties included in the CoP of 2017 with further information regarding their descent, where it was available in the public domain. Six traditional and 35 evolved cultivars are currently notified as Basmati in India and Pakistan. Traditional varieties were selected and cultivated by farmers over generations and rice research institutes selected pure lines from these seeds. New varieties were evolved by crossing the traditional lines with high yielding non-Basmati indica cultivars. In 2005 it was a common understanding among Indian and Pakistani plant breeders that authentic Basmati has to be either traditional or evolved from breeding with at least one traditional parent. The 15 varieties in the first CoP followed this rule.

Our recent publications on SSR and DNA fingerprinting



ANALYTICAL TECHNOLOGIES



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The DNA fingerprint in food forensics: the Basmati rice case

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ANALYTICAL TECHNOLOGIES



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The DNA fingerprint in food forensics part II: the Jasmine rice case

KEYWORDS: Thai Agricultural Standard, Cambodian Rice Standard, French Rice Code, Microsatellites, SSRs (simple sequence repeats), food fraud, fragrance gene *gr*, NLRot dendrogram

ABSTRACT

Jasmine rice is the customary name for premium fragrant cultivars originating from the lowlands of the Central East of Thailand and the southern part of Cambodia. In contrast to the UK Code of Practice (CoP) which is well defined in the pioneering UK Code of Practice (CoP) by a joint effort of all stakeholders in the UK, India and Thailand, there is no common understanding about Jasmine rice authenticity. The French Rice Code includes 3 varieties KDML105, KD13 and Phumthani 1 as Thai Jasmine rice and cultivars from Cambodia with similar characteristics as Jasmine rice. In contrast the standard defines 6 varieties and the Cambodian standard five cultivars as Jasmine rice. The success of the UK CoP is due to its clarity and restriction to certain cultivars, geographical regions and specific characteristics affecting the cooking and appearance of the rice. DNA fingerprinting is defined as the standard method for authenticity testing. This report reveals that the genetic fingerprinting method based on 15 microsatellites or SSR (simple sequence repeat) markers, which was recently developed for the differentiation of the 41 Basmati varieties in the revised UK CoP, can be also applied to Jasmine rice. Based on authentic reference materials obtained from the Cambodian Agricultural Research and Development Institute (CARDI) and from the trade the test not only allows the application of the French Rice Code, but also of the Cambodian Milled Rice Standard. This might lead to more transparency for the trade and consumers, increase the quality of this premium rice and contribute to its success on the world markets.

INTRODUCTION

DNA fingerprinting was invented by Sir Alec Jeffreys and first applied as a forensic tool in an immigration dispute (1). Since then it became the gold standard in paternity testing and human forensics to identify individuals during criminal investigations. Also in food forensics it is a standard tool for the differentiation of plant varieties and animal breeds (2, 3, 4). Authenticity testing of Basmati rice is the best example of its routine application for food control (4, 5, 6). Basmati is a premium fragrant rice with defined geographic origins and typical cooking characteristics. Due to its higher price adulterations with cheaper common long grain rice have been frequently observed. As a consequence the UK Rice Association, British Rice Millers Association and British Retail Consortium developed the UK Code of Practice (CoP 7), which defines Basmati authenticity and determines DNA fingerprinting as the standard method for the application of the Code.

Jasmine rice is an aromatic rice specialty from Southeast Asia with superb cooking characteristics. Its fragrance is similar to Basmati rice or pandan grass with 2-acetyl-1-pyrone as the major aroma compound. Recently it has

been observed that Jasmine rice is increasingly adulterated with cheaper rice of lower quality. Accordingly laboratory testing methods are needed to protect the consumer against misleading product claims. Furthermore the EU Vietnam Free Trade Agreement (EVFTA) of 2019 provides for the import of about 30,000 metric tons of 9 specific fragrant Vietnamese rice varieties for zero duty and the authenticity of these exports has to be verified by the customs authorities.

Rice exports are of great commercial importance for the countries of Southeast Asia with a total value of 8.5 billion USD in 2018 (8). A large fraction of this is fragrant rice, which accounts for 17.4 % of all rice exports from Thailand in 2018 (9) and 22 % from Vietnam in 2016 (10). The largest products of fragrant rice are Hom Mali (registered mark, wording means fragrant Jasmine in the Thai language) from Thailand, Phka Malu (also sold under the collective mark "Mays Angkor", registered with WFO, the World Intellectual Property Organization) from Cambodia and Jasmine 85 from Vietnam (10).

For testing the authenticity of Basmati rice a DNA fingerprinting method had been developed by Bleigh (11), which became the standard test in the UK Code of Practice on Basmati rice (CoP 7). This test is based on a second generation fingerprinting procedure with SSR markers and allows the identification and quantification of all rice varieties and also in mixtures, as long as the genetic fingerprints have been determined from reference materials (12). Recently a method based on 15 SSR markers and the fragrance gene *gr* was introduced for the differentiation of the 41 Basmati varieties, which are listed in the revised CoP of 2017 as genuine Basmati (12). This report reveals that this method is also suitable for the authenticity testing of Jasmine rice and might lead to more consumer transparency and improve the quality of this Southeast Asian specialty.

RESULTS AND DISCUSSION

Authenticity definition of Jasmine rice by Southeast Asian and European standards

Similar to Basmati rice the authenticity and quality of Jasmine rice is defined by varieties and their physical, cooking and biochemical characteristics. According to Thai specifications for Jasmine rice (13, 14) the milled kernel has to be long, slim (average length of whole kernels > 7 mm, length/width ratio > 3.2:1), partly and while in the Jasmine flower. When cooked the rice is moist, soft in texture and somewhat sticky. The amylose content is low with a maximum of 20 % and the alkali spreading value of 6 to 7 indicates a low gelatinization temperature

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DNA markers for Basmati authentication have the power to distinguish among other global economically relevant rice varieties and to evaluate their genetic background

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Risotto
Jasmine rice
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Principal coordinate analysis
Fragrance gene *gr*

ABSTRACT

DNA fingerprinting based on 15 SSR (Simple Sequence Repeat) markers was introduced in the early 2000s for authenticity testing of Basmati rice. Subsequently the addition of 5 SSRs and the fragrance gene *gr* have refined the method for routine use. This study evaluated the applicability of the 15-SSR method for authenticity testing of more diverse types of commercially relevant rice that are traded on an international scale. DNA fingerprints of 158 rice varieties from 14 countries across four continents were obtained with this method. Most had distinct marker profiles except for eight near isogenic lines and eight closely related traditional varieties. The *gr* marker detected several non-Basmati varieties that were incorrectly labelled as Jasmine fragrant rice, one of which was listed as fragrant and left-out in the EU Viet Nam Free Trade Agreement. To assess the authenticity of samples obtained from unofficial sources in the trade, UPCOMING algorithm and Principal Coordinate Analysis (PCA) were used for marker-based clustering of samples. Most of the unofficially sourced samples clustered according to their reported geographical and genetic origin, supporting their authenticity. The study supports the broader utility of this 15-SSR test, supplemented by the *gr* marker, for global rice variety authentication.

1. Introduction

DNA analysis is routine procedure in food analysis for the detection of certain species, varieties, pathogens and genetically modified organisms. Species can be differentiated by comparing the sequences of specified barcoding genes (Primmer, 2019) but varieties of plants and breeds of animals can be distinguished by DNA fingerprinting using highly polymorphic mini-satellites (tandem repeats), microsatellites (simple sequence repeats; SSRs) and single nucleotide polymorphisms (SNPs) (Nader et al., 2016). Multi-allelic SSRs have higher discriminatory power compared to SNPs.

Rice (*Oryza sativa* L.) is a globally important staple food with extensive genetic diversity. Over 132,000 rice accessions and wild relatives are maintained in gene banks providing a vital source of traits for breeding, however, only a fraction of them are commercially relevant varieties (International Rice Research Institute IRRI, 2020). Rice is cultivated on more than 163 million hectares in over 100 countries in

diverse cropping systems and environments (Lahorte et al., 2017). Cultivated varieties are adapted to different climates, soils and resistance to pests. Diversity in grain morphology, starch structure and fragrance gives rise to different culinary uses, such as Basmati in Biryani and Pilaf, Jasmine in Curries, and Japonica in Sushi and Risotto.

Commercial rice varieties (except for F₁ hybrids) are genetically homozygous and therefore ideally suited for DNA fingerprinting (Ramakrishana et al., 1994). Almost 20,000 SSRs are listed in the Gramene database (Gramene, 2022); McCouch et al., 2002). Subsets of SSRs have been used to assess genetic diversity and population structure in rice (Goudarthy et al., 2013; Goldenhar & Pollock, 1997; Jaisin Aljamali et al., 2018; Lestari et al., 2009; Ma et al., 2002; Nagaraja et al., 2000; Singh et al., 2013, 2016; Takekazi & Nei, 1996; Thomson et al., 2007; Verma et al., 2019). Other DNA-based methods have been developed for rice authenticity testing (Vieira et al., 2022) while Bradbury et al. (2005a and b) developed a PCR test for a major rice gene for fragrance (*gr*).

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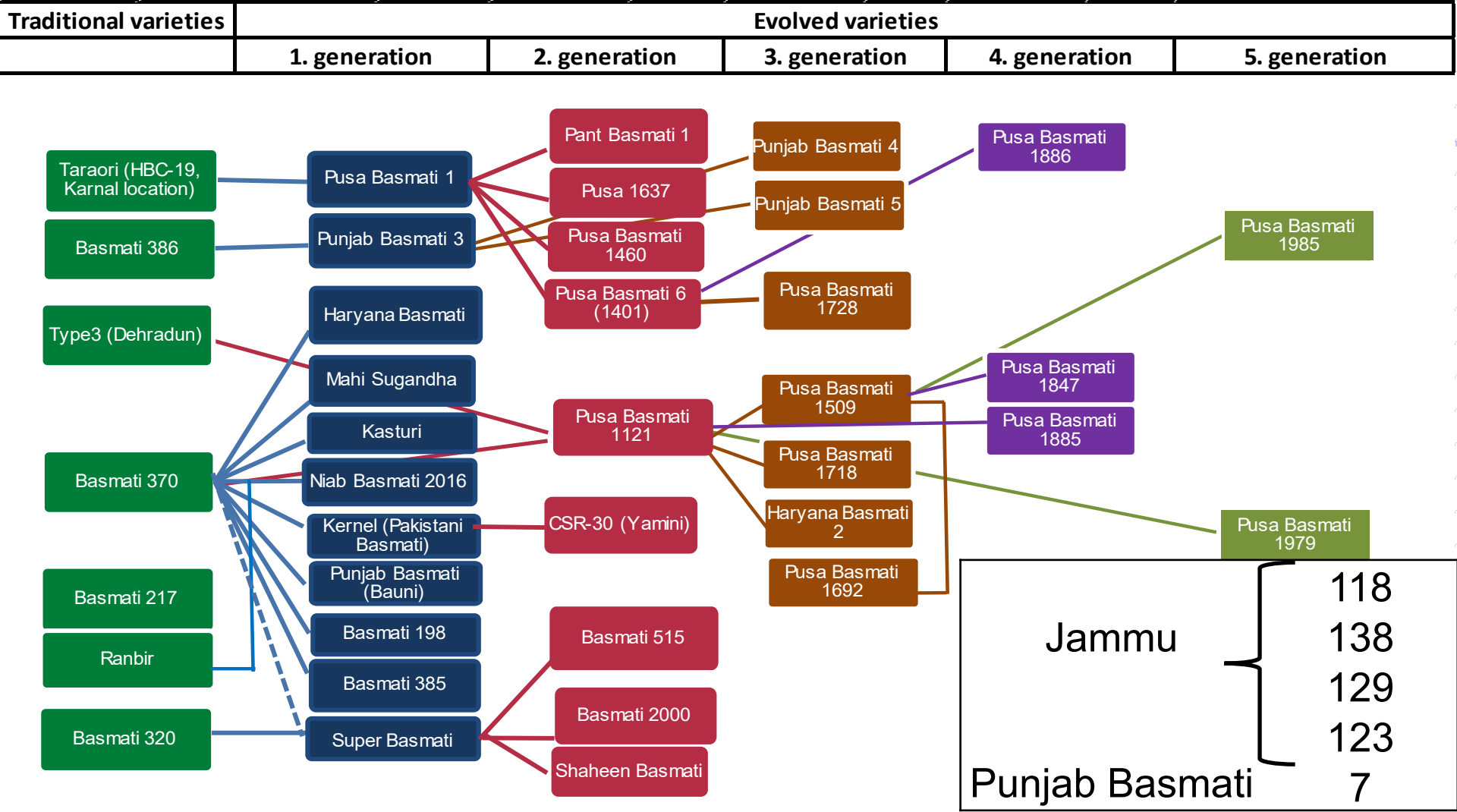
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Basmati in the Code of Practice and DNA fingerprints

No	Variety and origin	RM 1	RM223	M 16	RM202	RM44	RM201	RM229	RM241	RM 171	RM55	RM263	RM 152	RM212	RM252	RM72	fgf	
1	Basmati 217																	
2	Basmati 370*	W	W	Z	Y	X	X	Y	Z	Y	Z	159	144	116	233	170	D	
3	Type 3 (Dehradun)*	W	W	Z	Y	X	X	Y	Z	Y	Z	163		116	235		D	
4	Ranbir Basmati*	W	W	Z	Y	X	X	Y	Z+4	Y	Z	159	144	116	221	170	D	
5	Taraori Basmati*	W	W	Z	Y	Y	X	Y	Y	Y	X	163	144	116	239	170	D	
6	Basmati 386*	W	W	Z	Y	Y	X	Y	Y	Y	X	163	144	116	239	170	D	
7	Kernal (Pakistan Basmati)*	W	W	Z	Y	Y	X	Y	Y	Y	X	163	-	-	-	-	-	
8	Pusa Basmati 1*	W	W	Y	Y	Y	X	X	Y	Z	Y	163	148	116	255	155	D	
9	Super Basmati*	W	W	Z	Y	X	X	Y	Z	Z	X	-	144	116	239	-	D	
10	Basmati PK-385*	Y	W	Z	X	Y	X	Y	Z	Y	Z	163		134			D	
11	Basmati PK-198*	Y	W	Z	X	X	X	Y	Z	Y	Z	159		134			D	
12	Mahi Sugandha*	Y	X	Z	X	W	Z	X	Z	Z	Y	-	-	-	-	-	D	
13	Kasturi*	W	V	Y	Y	W	X	Y+2	Z	Z	Y	202	144	114	233	146	D	
14	Haryana Basmati*	Z+2	W	Y	X	W	X	X	Y	Z	Y	159	144	134	215	155	D	
15a	Punjab Basmati (Bauni) ¹	Z+5	Y	Z	X	X	X	Y	Z	Y	Z	-	-	-	-	-	-	
15b	Punjab Basmati (Bauni) ¹	Y+2	Y	Z	X	X	X	Y	X-4	Y	Z+3	159	-	134	-	-	-	
16	Basmati 2000*	W	W	Z	Y	X	X	Y	Z	Z	X	163	155	134	233	170	D	
17	Basmati 515*	W	W	Z	Y	X	X	Y	Z	Z	X	163	144	134	233	170	D	
18	Shaheen Basmati*	W	W	Z	Y	Y	X	Y	Z	Z	X	163	144	134	233	170	D	
19	Kissan Basmati*	W	V	Y	Y	W	X	Y+2	Y	Z	Y	163	134	116	215	170	D	
20	NIAB Basmati 2016*	W	W	Z	Y	X	X	Y	Z	Z	Z	163	144	116	233	170	D	
21	Noor Basmati*	Y+2	W	Y	Y	W	W	Y+2	Y	Z	Y	180	154	134	215	155	D	
22	Basmati CSR-30*	W	W	Z	Y	Y	X	Y	Y	Y	X	163	144	116	239	170	D	
23	Pusa Basmati 1401*	W	W	Y	Y	Y	X	X	Y	Z	Y	163	148	116	255	170	D	
24	Pusa Basmati 1460*	W	W	Y	Y	Y	X	X	Y	Z	Y	163	154	116	253	155	D	
25	Pusa Basmati 1609*	Z	V	Y	X+2	W	X	X	Y	Z	Y	163	154	114	215	155	D	
26	Pusa Basmati 1637*	W	W	Y	Y	Y	X	X	Y	Z	Y	163	148	116	255	155	D	
27	Pusa Basmati 1728*	W	W	Y	Y	Y	X	X	Y	Z	Y	163	148	116	255	170	D	
28	Pusa Basmati 1121*	W	W	Y	Y	Y	X	X	Y	Y	X	163	148	116	255	170	D	
29	Pusa Basmati 1509*	W	W	Y	Y	Y	X	Y+2	Y	Z	X	163	154	114	259	170	D	
30	Punjab Basmati 2*	W	W	Z	Y	X	X	Y	Y	Z	X	165	144	116	237	170	D	
31	Punjab Basmati 3*	W	W	Z	Y	Y	X	Y	Y	Y	X	163	144	116	239	170	D	
32	Vallabh Basmati 22*	W	W	Z	Y	Y	X	Y	Y	Y	Z	163	144	116	255	155	D	
33	Vallabh Basmati 23*	W	W	Z	Y	Y	X	Y	Y	Y	Y	Z	163	144	116	255	155	D
34	Basmati 564*	W/Y	W	Y/Z	X/Y/ Y+4	W-2/Y	X/Z	X/Y	Y/Z	Y	X/Z	161/ 163	144/148 / 154	116/ 134	215/ 255	155/ 161	D	
35	Pant Basmati 2*	Z	W	Z	X	W	Z	X+2	Y	W	Y	202	148	134	233	155	D	
36	Pusa Basmati 1692*	W	W	Y	Y	Y	X	Y+2	Y	Z	X	163	155	114	215	170	D	
37	Pusa Basmati 1718*	W	W	Y	Y	Y	X	X+2	Y	Y	X	163	155	116	255	170	D	
38	Punjab Basmati 4*	W	W	Z	Y	Y	X	Y	Y	Y	X	163	148	116	255	170	D	
39	Punjab Basmati 5*	W	W	Z	Y	Y	X	Y	Y	Y	X	163	144	116	239	170	D	
40	Haryana Basmati 2*	W	W	Y	Y	Y	X	X	Y	Y	X	163	148	133/116	255	170	D	

Chenab Basmati
Punjab Basmati
Pant Basmati 1
Malviya Basmati
Shan 10-9
Vallabh Basmati 21
Vallabh Basmati 24

No fragrance gene fgr

New varieties notified at origin			
Pusa	1847	Jammu	118
	1885		138
	1886		129
	1985		123
Basmati	1979	Punjab B,	7
	C 622	PK	1121
Basmati	2020		2021
	Super	KSK	111 H
	Gold Sona Vital		
NIAB	HY 18		
	HT 39		

Our testcodes: BJ027 and BJB0F

How to identify newly developed varieties without reference materials?



Indian Council of Agricultural Research



Rice
Pusa Basmati 1885
(Variety)

Traits improved: Bacterial blight & blast resistance

1. Genes introgressed : *Xa21, xa13, Pi2 and Pi54*
2. Molecular markers used : SSR
3. Recurrent parent : Pusa Basmati 1121
4. Donor parent : Pusa 1883/Pusa Basmati 1718
5. Salient features :
 - Bacterial blight and blast resistant
 - Average grain yield: 47.0 q/ha
 - Maturity: 145 days
 - Plant height: 135 cm

pTA248

xa13prom

AP5659-5

Pi54MAS



Indian Council of Agricultural Research

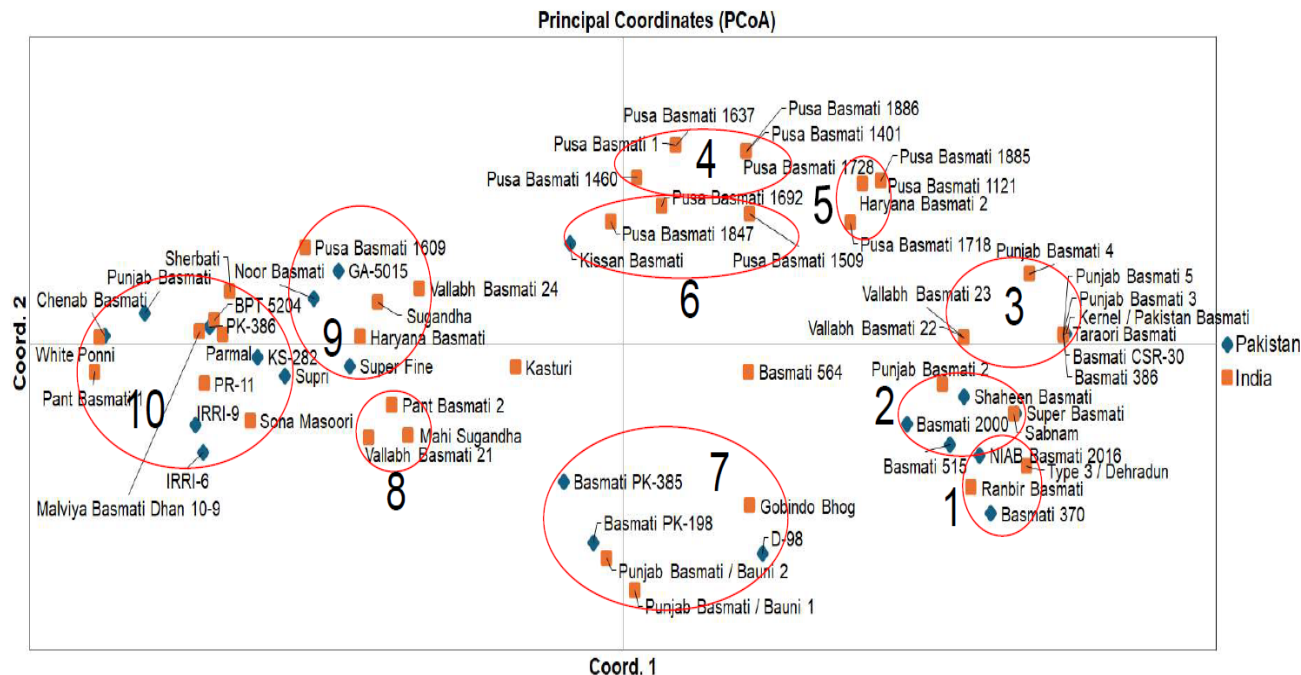


Rice
Pusa Basmati 1886
(Variety)

Traits improved: Bacterial blight & blast resistance

1. Genes introgressed : *Xa21, xa13, Pi2 and Pi54*
2. Molecular markers used : SSR
3. Recurrent parent : Pusa Basmati 6
4. Donor parent : Pusa 1602 (*Pi2* and *Pi54*)/ Pusa 1603 (*xa13* and *Xa21*)
5. Salient features :
 - Bacterial blight and blast resistant
 - Average grain yield: 45 q/ha
 - Maturity: 145 days
 - Plant height: 95 cm

Principle Coordinate clustering analysis of Basmati



- 1: Basmati 370 family
- 2: Super basmati family
- 3: Taraori/Kernel family
- 4: Pusa Basmati 1 family
- 5: Pusa Basmati 1121 family
- 6: Pusa Basmati 1509 family
- 10: adulteration cluster

Standards defining Jasmine rice



รวมมาตรฐานสินค้าข้าวไทย
Thailand Standards for Rice

กระทรวงพาณิชย์
กรมการค้าต่างประเทศ
563 ถนนพญาไท แขวงวังใหม่ เขตปทุมวัน กรุงเทพฯ 11000
โทรศัพท์ : 0-2547-4140
โทรสาร : 0-2547-4140
E-mail : trade@do.go.th
Website : http://eccd.go.th/



Syndicat de la
Rizerie
Française

Cambodian Milled Rice for Exports

Cambodia offers Indica type of rice as ...

Premium Fragrant or Cambodian Jasmine Rice | Fragrant | Long grain White or Premium White | White | Brown/Cargo

TYPE	CLASSIFICATION	NAMES
Jasmine Rice	Premium Fragrant Dry Season	Phka Malis Phka Rumduol
Fragrant	Fragrant Wet Season	Sen Kra Ob Sen Pidao
White	Premium White Wet Season	Ginger Rice Phka Knhey Phka Chan Sen Sar
White	White Wet season	Pearl Rice Neang Khon Rengchey Ponia Pdao Neang Minh
White (IR)	Dry Season IR	

POINT 6 – DÉNOMINATION DES AUTRES RIZ PARFUMÉS

6.2. Origine Thaïlande

Les caractéristiques minimales des variétés de riz Thaï parfumé : dimension des grains, teneur en amylose et arôme, satisfont aux spécifications du tableau 2.

	Hom Mali	Pathumtani
Longueur minimale moyenne avant cuisson	7 mm	7 mm
Teneur en amylose	13 – 18 %	16 – 20 %
Ratio longueur/largeur	Supérieure à 3,2	Supérieure à 3,2
Arôme typique du riz thaï parfumé	présent	présent

Pour les dénominations « Riz Parfumé de Thaïlande » ou « Riz Parfumé Thaï » ou « Riz Fragrant de Thaïlande », « Riz Fragrant Thaï » ou « Riz Jasmine Thaï », le riz doit être constitué de 80 % minimum de la variété Pathumtani ou de 92 % minimum de la variété Hom Mali.

Les dénominations « Riz Parfumé de Thaïlande » ou « Riz Parfumé Thaï » ou « Riz Fragrant de Thaïlande », « Riz Fragrant Thaï » ou « Riz Jasmine Thaï » peuvent être complétées par la mention Hom Mali s'ils sont constitués à 92 % minimum de Riz de Thaïlande Hom Mali (variétés Kao Dok Mali 105 et RD 15 (aussi appelée Kor Khor 15)).

L'identification des variétés est mesurée par des tests ADN.

La liste des variétés de riz parfumés d'origine Thaïlande est mentionnée dans l'annexe 6.

6.3. Autres origines que Thaïlande

Riz Parfumés, riz Fragrant autres que Thaïlande : Dans ce cas, l'information doit obligatoirement être complétée par l'indication du ou des pays d'origine dans l'étiquetage.

L'indication de l'origine peut, au choix, compléter la dénomination (elle est dans ce cas mentionnée à proximité immédiate de la dénomination) ou figurer ailleurs sur l'emballage, conformément à la réglementation en vigueur en matière d'étiquetage.

La **dénomination « riz Jasmine »** peut également être employée pour des riz en provenance du Cambodge et du Vietnam.

DNA fingerprints of Southeast Asian rice varieties

Variety and origin			RM1	RM223	M16	RM202	RM44	RM201	RM229	RM241	RM171	RM55	RM263	RM152	RM212	RM252	RM72	fgr
Thailand																		
Jasmine	67	Hom Mali ^b	Z+5	V	Y	Y	W+2	W	X	Y-2	Z	Z+2	190	143	114	233	146	D
	68	Pathum Thani 1 ^b	Z+5	V	Y	Y+4	W	W	X	Y	Z+4	Y	185	143	112	247	155	D
	69	RD79	W	Y	Y	Y	W	Z	X	Y	Z	Y	202	155	134	215	155	ND
Cambodia																		
Jasmine	70	Phka Romeat ^c	Z+5	V	Y	Y	W+2	W	X	Y-2	Z	Z+2	190	143	114	233	146	D
	71	Phka Rumdeng ^c	Z+5	V	Y	Y	W+2	W	X	Y-2	Z	Z+2	190	148	114	233	146	D
	72	Phka Rumduol ^c	Z+5	V	Y	Y	W+2	W	X	Y-2	Z	Z+2	180	143	114	233	146	D
	73	Sen Kra Oub ^c	W+6	V-8	Y	X	W+2	W	Y+2	Y	Z	Y	202	154	133	193	146	D
	74	Sen Pidao ^c	Z	V	Y	Y	W	Z	Y+2	Y	Z+4	Y	185	154	113	193	155	D
	75a	SRO Ngear	Z	V	Y	Y	W	W	Y+2	Y-8	W	Y	183	144	134	215	155	D
	75b	SRO Ngear	Z	V	Y	Y	W	W	Y+2	Y-8	W	Y	181	155	134	215	155	ND
	76	Phka Knhey (Ginger rice) ^c	Z	Y	Y	Y+4	X+2	W	X	Y	Z+4	Y	183	140	112	215	146 /	D
	77	Phka Chan Sen Sar ^c	Z	V-8	Y	X+4	Y+4	Z	Y+2	Y-6	Z	Y	188	132	114	229	152	ND
	78	CAR4 ^c	Z+2	V-8	Y	X	W	W-2	Y+2	Y-2	W	Y	188	148	113	250	146	ND
	79	CAR6 ^c	Z+2	V-8	Y	X	W	W-2	Y+2	Y-2	W	Y	188	148	113	254	152	ND
	80	Chul's Sa ^c	Z	Y	Y	Y	W	Z	Y+2	Y	Z+4	Y	202	154	133	215	155	ND
	81	Damnoeb Sbai Mongkul ^c	Z	V-8	Y	X+4	W	W	X	Y-2	Z	Y	190	154	131	225	152	ND
	82	IR66 ^c	Z	Y	Y	Y+4	W	W	Y+2	Y-4	W	Z	190	154	133	248	161	ND
	83	Riang Chey ^c	Z+2	V-8	Y	X	W	W-2	Y+2	Y-2	W	Y	188	148	113	256	152	ND
Vietnam																		
Vietnamese fragrant rice	84	Jasmine 85 ^d	Y	V	Y	Y	W+2	W	X	Y	Z	Y	190	-	-	-	-	D
	85	NÀNG HOA 9 ^d	Y	V	Y	Y	W+2	W	X	Y	Z	Y	190	148	112	215	146	D
	86	ST 20 ^d	Z+5	V	Y	Y+4	W	W	X	Y	Z+4	Y	183	144	112	245 / 239 / 233	155	D
	87	St 24	Z+5	V	Y	Y+4	W	W	X	Y-8	Z+4	Y	183	155	112	218	155	D
	88	ST 25	Z+5	V	Y	Y+4	W	W	X	Y-8 / Y	Z+4	Y	185	155	112	218/242	155	D
	89	OM 18	Y-2	V	Y	Y+4	W+2	W	X	Y	W	Y	180	155	116	215	146	D
	90	OM4900 ^d	Y-2	V	Y	Y	Y+4	W	X	Y	Z	X	202	155	112	215	155	D
	91	VD 20 ^d	Z	V	Y	Y+4	W+2	W	X	Y	Z	Y	183	144	134	215	146	D
	92	LT 28	Y-2	V-8	Y	Y	W	Y+4	X	Y	Y	Y	202	155	134	215	161	D
	93	OM 5451 ^d	Z	Y	Y	Y+4	X+2	W	X	Y	Z+4	Y	183	140	112	215	-	ND
Myanmar																		
	94	Paw San	W+10	W-2	Y	Y+2	Y-2	W	Y+2	Y	X-3	Z	161	144	115	240	170	ND

Variety	Category	Fragrance	Origin
Hom Mali (KDM105 and RD15)	Thai Jasmine	yes	Thailand
Pathum Thani 1	Thai Jasmine	yes	Thailand
RD79	long grain	no	Thailand
Phka Romeat	Camb. Jasmine	yes	Cambodia
Phka Rumdeng	Camb. Jasmine	yes	Cambodia
Phka Rumduol	Camb. Jasmine	yes	Cambodia
Sen Kra Oub	Camb. Aromatic rice	yes	Cambodia
Sen Pidao	Camb. Aromatic rice	yes	Cambodia
SRO Ngear fragrant variety	Camb. Aromatic rice	yes	Cambodia
SRO Ngear non-fragrant variety	medium to long grain	no	Cambodia
Phka Knhey (Ginger rice)	medium to long grain	no	Cambodia
Phka Chan Sen Sar	medium to long grain	no	Cambodia
CAR4	medium to long grain	no	Cambodia
CAR6	medium to long grain	no	Cambodia
Chul's Sa	medium to long grain	no	Cambodia
Damnoeb Sbai Mongkul	medium to long grain	no	Cambodia
IR66	medium to long grain	no	Cambodia
Riang Chey	medium to long grain	no	Cambodia
Jasmine 85	Vietnamese fragrant	yes	Vietnam
NÀNG HOA 9	Vietnamese fragrant	yes	Vietnam
ST 20	Vietnamese fragrant	yes	Vietnam
St 24	Vietnamese fragrant	yes	Vietnam
ST 25	Vietnamese fragrant	yes	Vietnam
OM 18	Vietnamese fragrant	yes	Vietnam
OM4900	Vietnamese fragrant	yes	Vietnam
VD 20	Vietnamese fragrant	yes	Vietnam
LT 28	Vietnamese fragrant	yes	Vietnam
OM 5451	Vietnamese long grain	no	Vietnam

Standards of Thai Fragrant Rice

Appended to Notification of Ministry of Commerce

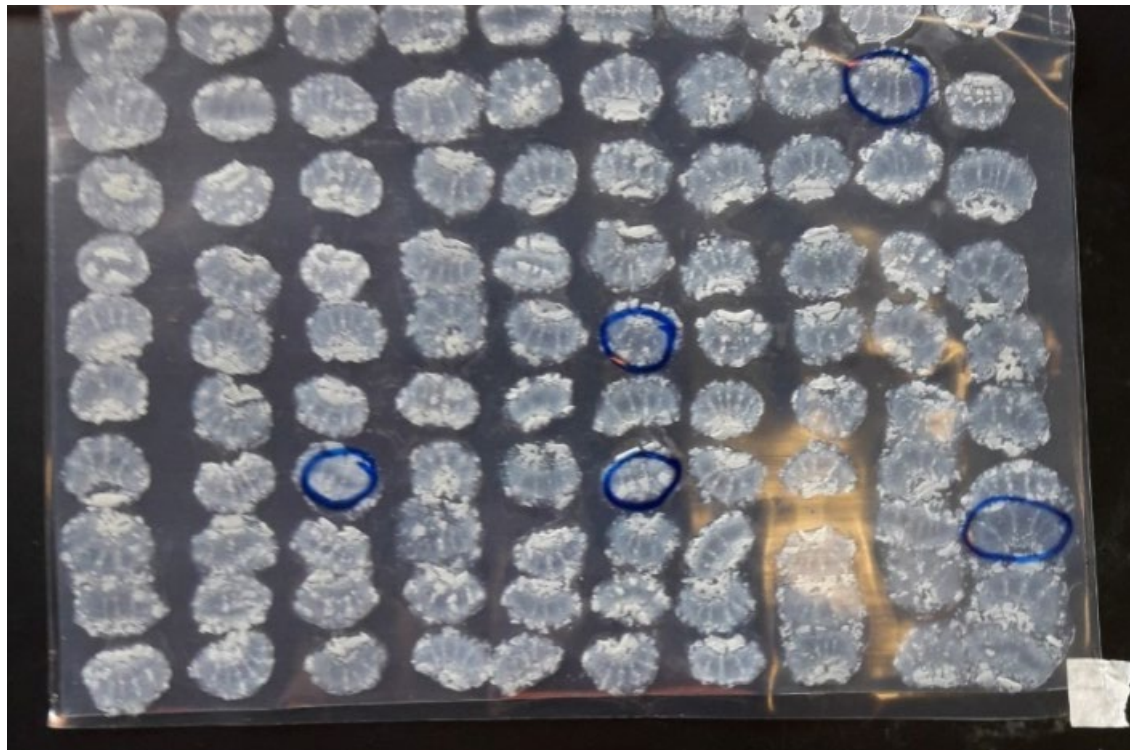
Subject: Standards of Thai Fragrant Rice B.E. 2559

Clause 1 Definitions

- (1) Thai Fragrant Rice (Thai **Jasmine** Rice, Thai Aromatic Rice or any other names of the same meaning) means Cargo rice and White rice that are processed from the non-glutinous rice paddy of fragrant varieties that are produced in Thailand and certified by Ministry of Agriculture and Co-operative as non-glutinous rice of fragrant varieties. They have natural aroma depending on whether they are new or old crop. The cooked rice of which has tender texture.



The glass squeezing test – ONLY! a simple preliminary test method, for indication, only



APPENDIX D

Method for checking cooked rice kernels boiled in water
(A simple preliminary test method for indication only)

1. Apparatus

- 1.1 Electric pot
- 1.2 Stainless metal basket
- 1.3 Spoon or paddle for stirring rice kernels
- 1.4 Two glass sheets for pressing rice kernels

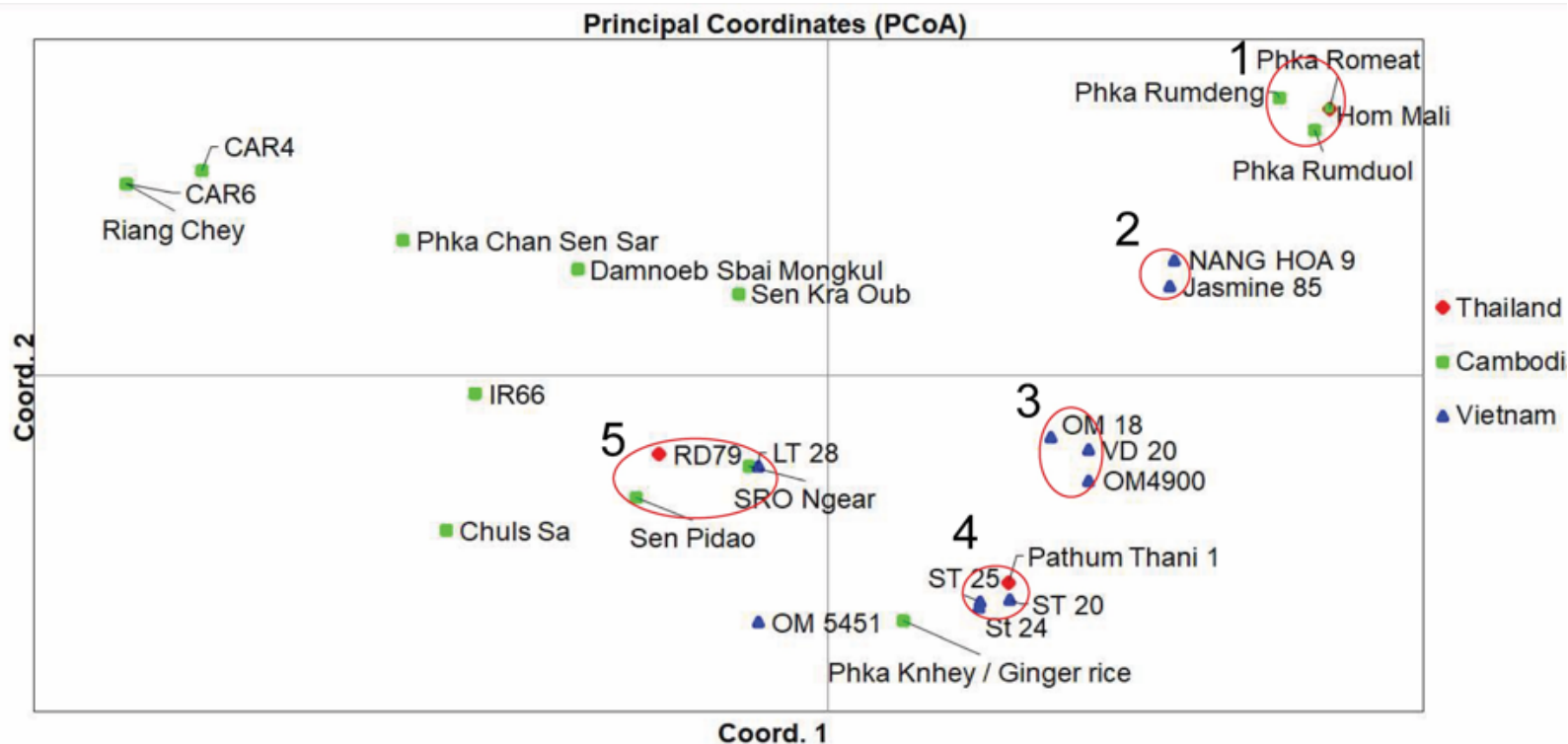
2. Test method

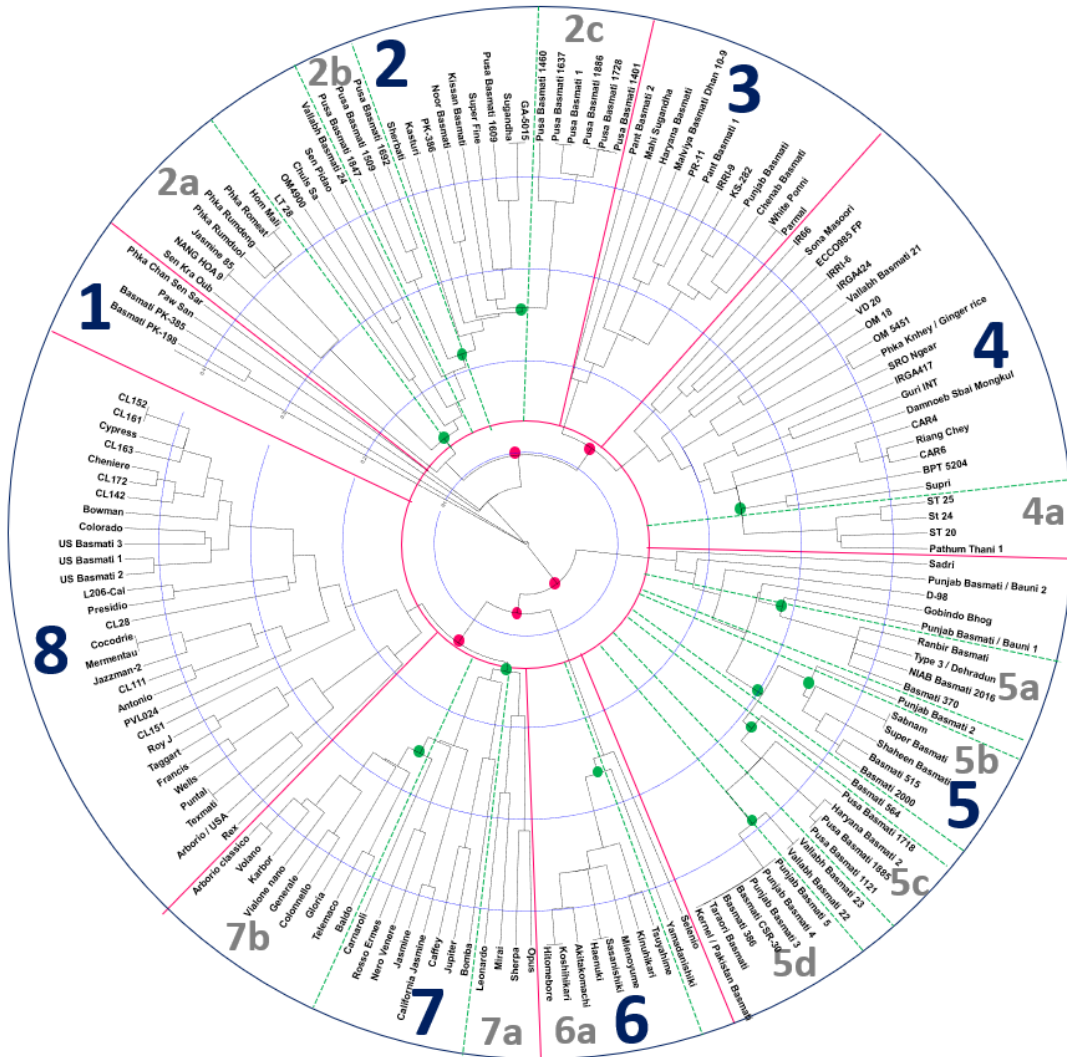
- 2.1 Select 100 white rice kernels randomly and put them in the basket.
- 2.2 Boil distilled water in the electric pot.
- 2.3 Dip the basket with the rice kernels in the boiling water (as in 2.2) for a period as calibrated against the alkali spreading value method, during which ensure that the rice kernels do not stick with each other.
- 2.4 On completion of the boiling period, lift up the basket from the boiling water and immediately dip it into the cold water, then lift up for draining.
- 2.5 Spread the rice kernels on the glass sheet. Place another glass sheet over the rice kernels and press them flat. The kernels that have white cores of raw starch inside are considered as not fully gelatinized.

3. Judgement

The kernels that are not fully gelatinized are not considered Thai Hom Mali rice.

PCoA clustering analysis of Jasmine rice





UPGMA Clustering of 160 rice varieties worldwide

2, 3, 5 Basmati

2, 4 Jasmine

6 Japanese varieties

7 Italian varieties

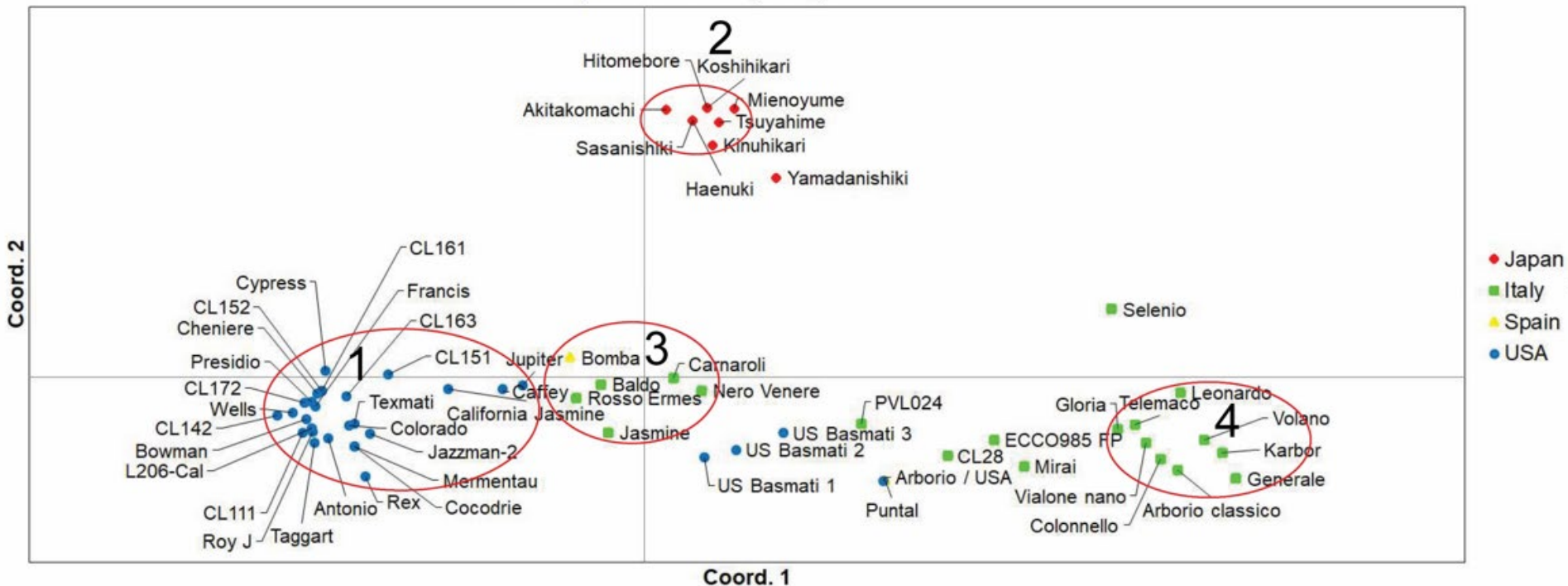
8 US varieties

UPGMA algorithm: Unweighted Pair Group Method with Arithmetic mean

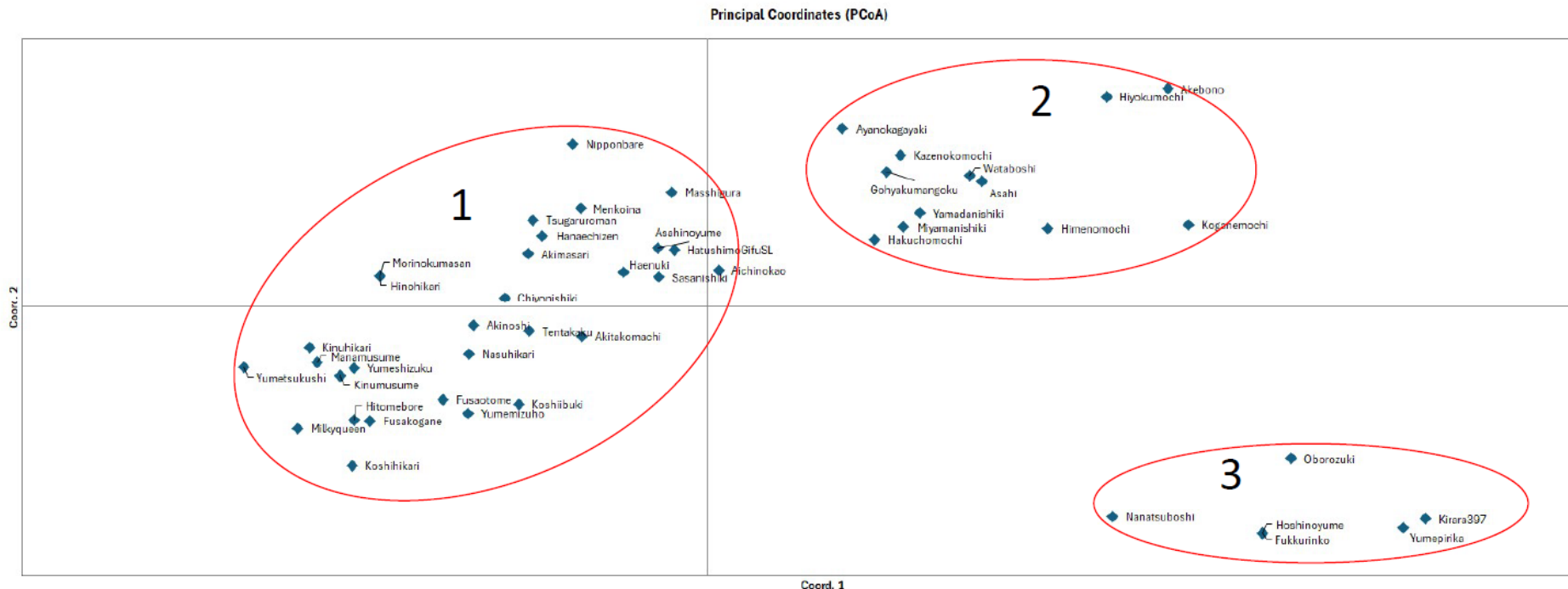
Source: Nader, W.F.; Steele, K.; Krickl, L.; Brendel, T.; and Schubert, R.: Authenticity testing of commercially relevant rice varieties on an international scale by DNA fingerprinting and UPGMA and PCoA clustering analysis. Submitted for publication to *Food Control* strictly prohibited.

PCoA clustering analysis of Risotto and Sushi rice

Principal Coordinates (PCoA)



PCoA clustering analysis of Japanese varieties



Analysis with a set of 24 SSR markers, two on each of the 12 rice chromosomes

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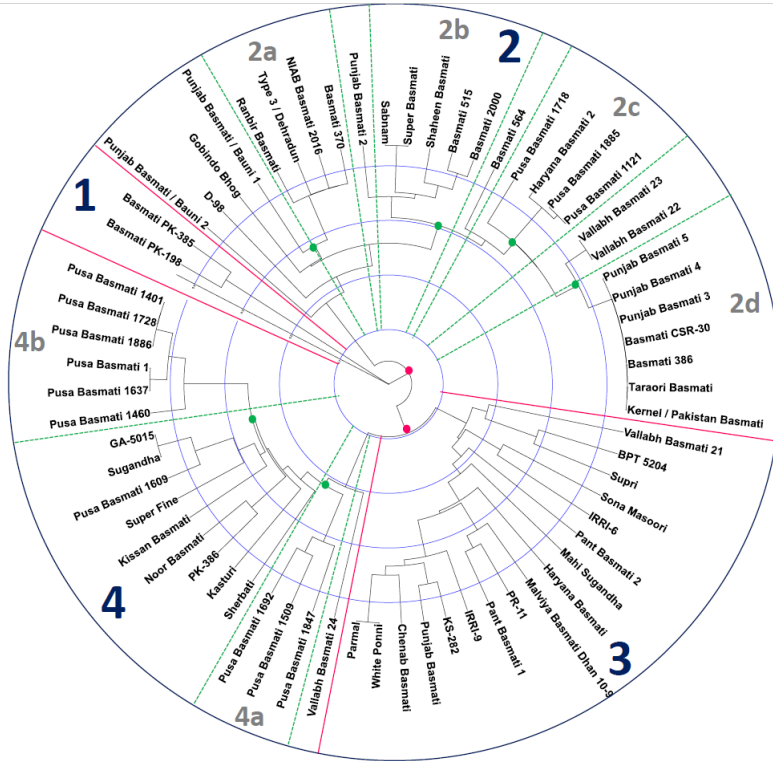
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UPGMA clustering of Basmati rice



2a: Basmati 370 family

2b: Super basmati family

2c: Pusa Basmati 1121 family

2d: Taraori/Kernel family

4a: Pusa Basmati 1509 family

4b: Pusa Basmati 1 family

How to identify newly developed varieties without reference materials?



Indian Council of Agricultural Research



Rice
Pusa Basmati 1985
(Variety)

Trait improved: Herbicide (Imazethapyr) tolerance

1. Gene introgressed : *AHAS*
2. Molecular markers used : SSR
3. Recurrent parent : Pusa Basmati 1509
4. Donor parent : Robin
5. Salient features :
 - ♦ Imazethapyr herbicide tolerant
 - ♦ Average grain yield: 52 q/ha
 - ♦ Maturity: 115 days
 - ♦ Plant height: 110 cm

RM6844



Indian Council of Agricultural Research



Rice
Pusa Basmati 1979
(Variety)

Trait improved: Herbicide (Imazethapyr) tolerance

1. Gene introgressed : *AHAS*
2. Molecular markers used : SSR
3. Recurrent parent : Pusa Basmati 1121
4. Donor parent : Robin
5. Salient features :
 - ♦ Imazethapyr herbicide tolerant
 - ♦ Average grain yield: 46 q/ha
 - ♦ Maturity: 133 days
 - ♦ Plant height: 125 cm