General introduction of Hybrid Rice Quality in China

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- National standard for rice variety quality
- Development of Hybrid Rice Grain Quality in China
- Grain Quality of Major Series of Hybrid Combinations
- Characteristic of Hybrid Rice Grain Quality

National standard for rice variety quality

1985: MOA organized a conference to improve rice grain quality

1986: *NY/T 20 High Grain Qualitiy Rice* was issued

2002: *NY/T 20* changed to *NY/T 593 Cooking Rice Variety Quality*

National standard for rice variety quality

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1. Milling quality

Brown rice rate

Milled rice rate

Head rice rate

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2. Appearance quality

Grain size (only used for classification of milling quality of indica rice)

Chalky grain, Chalkness Drgree

Transparency

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3. Cooking and eating quality

Gelatinization temperature (alkali spreading value)

Gel consistency

Amylose content (center at 18%)

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4. Nutrition quality

Protein content

5. Taste score (Max. of total score = 100)

Smell

Colour and Lustre,

Palatability

Flavour

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6. Quality Value

$$i = \frac{t_1 + t_2}{k} \times 100$$

i——Quality Value, %;

t_1——Total Testing Score;

t_2——Total Tasting Score;

k—Constant, 200.

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Total Testing Score

was the sum of weighted value of 11 parameters: brown rice rate, milled rice rate, head rice rate, chalky grain, chalkness degree, transparency, gelatinization temperature, gel consistency, amylose content, and protein content.

Maximum = 100

National standard for rice variety quality

- Evaluation

Rice grain quality was divided into five grades:

1~3: high quality 4~5: regular quality

The lowest level for one of the listed parameters: head rice yield, chalkness degree, transparency, amylose content and quality value, respectively, was used as the grade of rice grain quality for the sample.

National standard for rice variety quality

- Evaluation (Nonwaxy Indica Rice)

grade	HRY %			Chalkness %	Transparency	AC %	QV
	long	middling	short				
1	≥50.0	≥55.0	≥60.0	≤2.0	1	17.0～22.0	≥75
2	≥45.0	≥50.0	≥55.0	≤5.0	≤2	17.0～22.0	≥70
3	≥40.0	≥45.0	≥50.0	≤8.0	≤2	15.0～24.0	≥60
4	≥30.0	≥40.0	≥45.0	≤15.0	≤3	13.0～26.0	≥65
5	≥35.0	≥35.0	≥40.0	≤25.0	≤4	13.0～26.0	≥55

National standard for rice variety quality

- Evaluation (Nonwaxy Japonica Rice)

grade	HRY %	Chalkness %	Transparency	AC %	QV
1	≥72.0	≤1.0	1	15.0～18.0	≥85
2	≥69.0	≤3.0	≤2	15.0～18.0	≥80
3	≥66.0	≤5.0	≤2	15.0～20.0	≥75
4	≥63.0	≤10.0	≤3	13.0～22.0	≥70
5	≥60.0	≤15.0	≤3	13.0～22.0	≥65

Development of Hybrid Rice Grain Quality in China

- The three-line hybrid rice (Indica)
  - Indica hybrid rice was first released in China in 1973. Grain quality was limited because of high amylase content, short gel consistency and high chalky grain rate.
  - From 1984 to 1995, new male-sterile lines with high grain quality were chosen, such as Yuetai A, Zhong 9A.

Development of Hybrid Rice Grain Quality in China

- Two-line hybrid rice (Indica)
  - Two-lines hybrid rice research began in 1987.
  - Planting area of Liangyoupeijiu achieved 825 kha in 2002, and kept the biggest planting area among all hybrid rice varieties in China.
  - Grain quality: lower amylase content and longer gel consistency.

Development of Hybrid Rice Grain Quality in China

- Japonica hybrid rice

The field application of Japonica hybrid rice was low, planting area was less than 3% among all Japonica varieties till 2007.

Development of Hybrid Rice Grain Quality in China

Grain quality of first ten conventional rice varieties with highest planting areas in different years

1983				1993			
Variety		Plant area (kha.)	Quality	Variety		Plant area (kha.)	Quality
Guichao №2	I	1431	L	*Zhefu 802*	I	446	L
Guangluai №4	I	1110	L	*Wuyujing №3*	J	431	H
Yuanfengzao	I	717	L	*Jingxian 89*	I	329	M
Guichao №13	I	681	M	*Xiangzaoxian №7*	I	320	L
Shuanggui №1	I	571	M	*Wuyujing №2*	J	253	H
Hong 410	I	557	M	*Zhe 733*	I	206	L
Xianfeng №1	I	413	M	*Qishanzhan*	I	199	L
Nanjing №11	I	408	M	*Qiguizao 25*	I	173	L
Xiangzaoai №9	I	391	L	*Ewan №5*	I	173	H
Guanger 104	I	324	M	*Hejiang 19*	J	160	H

Development of Hybrid Rice Grain Quality in China

Grain quality of first ten conventional rice varieties with highest planting areas in different years

1999				2006			
Variety		Plant area (kha.)	Quality	Variety		Plant area (kha.)	Quality
Wuyunjing №7	J	614	H	*Kongyu 131*	J	700	H
Wuyujing №3	J	343	H	*Xudao №3*	J	320	M
Wuyunjing №8	J	327	M	*Longjing 14*	J	241	H
Suijing 3	J	293	M	*Jijing 88*	J	204	H
Jiayu 948	I	281	M	*Wujing 15*	J	185	M
Zaofeng №9	I	225	H	*Wuyunjing №7*	J	171	H
Kendao №8	J	219	H	*Wuyujing №3*	J	170	H
Hejiang 19	J	211	H	*Yanfeng 47*	J	142	M
Zhongyouzao 81	I	191	H	*Ningjing №1*	J	141	M
Liaojing 454	J	155	H	*Yujing №6*	J	136	H

Development of Hybrid Rice Grain Quality in China

Grain quality of first ten hybrid rice varieties with highest planting areas in different years

1983				1993			
Variety		Plant area (kha.)	Quality	Variety		Plant area (kha.)	Quality
Shanyou №2	I	2041	L	*Shanyou 63*	I	4868	M
Weiyou №6	I	1051		*Shanyou 64*	I	749	M
Shanyou №6	I	905	M	*D you 63*	I	713	M
Shanyou №3	I	222		*Weiyou 64*	I	625	
Siyou №6	I	74	M	*Shanyougui 99*	I	398	H
Aiyou №1	I	72	H	*Shanyougui 33*	I	297	L
Shanyou №8	I	70		*Boyou 64*	I	285	M
Nanyou №3		66		*Weiyou 46*	I	285	L
Siyou №30	I	57	M	*Shanyou №10*	I	281	L
Nanyou №2	I	54		*S64*	I	247	L

Development of Hybrid Rice Grain Quality in China

Grain quality of first ten hybrid rice varieties with highest planting areas in different years

1999				2006			
Variety		Plant area (kha.)	Quality	Variety		Plant area (kha.)	Quality
Shanyou 63	I	1439	M	*Liangyoupeijiu*	I	771	H
Gangyou 22	I	1151	M	*Jinyou 402*	I	535	L
II you 501	I	617	M	*Jinyou 207*	I	461	H
II you 838	I	515	L	*Jinyou 463*	I	417	M
Xieyou 46	I	424	L	*Fengliangyou №1*	I	400	M
Shanyou 46	I	311	L	*Gangyou 725*	I	284	M
Weiyou 46	I	303	L	*Jinyou 974*	I	240	M
Teyou 63	I	274	M	*II you 838*	I	235	L
Shanyou 77	I	263	M	*Yangliangyou №6*	I	205	H
Shanyoudouxi №1	I	247	M	*II youming 86*	I	189	M

Grain Quality of Major Series of Hybrid Combinations

- Ten types of rice male-sterile line
  100 rice male-sterile lines
  10000 hybrid combination
- Fifteen series of hybrid combinations were widely used in the field.

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  10000 hybrid combination
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Grain Quality of Major Series of Hybrid Combinations

- Grain quality was mainly inherited by male-sterile lines: low coefficient of variation (CV) in brown rice rate, milled rice rate, grain length and grain length/grain
- A feasible restorer line is important to keep high grain quality: high CV in head rice rate, chalky grain rate, chalkiness degree

Grain Quality of Major Series of Hybrid Combinations

Grain quality of series of Indica hybrid rice combinations

Series of hybrid rice combinations		CG %	CD %	T grade	AV grade	GC mm	AC %	PC %
Chuanyou	Ave.	49	8.2	1.8	5	68	18.4	9.9
n=34	CV	53.2	71.4	28.1	20.3	21	18.8	10.2
Yixiangyou	Ave.	28	4.6	1.7	5.7	72	16.9	9.4
n=44	CV	62.5	77.2	43.1	18.3	21.4	21.6	14
Neiyou	Ave.	23	3.9	1.4	5.3	70	15.8	10.7
n=25	CV	53.5	76. 9	35. 2	13.5	19.9	20.8	12.7
Liangxi	Ave.	40	7	2.1	5.1	71	18.9	9.8
n=194	CV	58.1	97.1	33.4	22	22.2	24.3	12

Grain Quality of Major Series of Hybrid Combinations

Grain quality of series of Indica hybrid rice combinations

Series of hybrid rice combinations		HR %	AV grade	GC mm	AC %	PC %
K you	Ave.	46.6	5.9	58	22.6	9.6
n=44	CV	28.2	11.2	25.7	5.8	14
Jinyou	Ave.	48.9	5.4	56	22.3	9.6
n=85	CV	29.8	18.1	25.2	8.6	15.1
D you	Ave.	49.7	5.6	54	22.1	9.1
n=99	CV	22.9	13.3	25.1	11.2	13.3
Teyou	Ave.	55.6	6.3	49	21.7	9.7
n=56	CV	21.5	11.6	29.2	9.4	9.9
II you	Ave.	57.3	5.6	51	21.7	9.9
n=99	CV	21.6	15.9	29	9.8	13.2

Grain Quality characteristics of Hybrid Rice

Comparing with conventional rice varieties :

- Indica hybrid rice had high milling quality
- Japonica hybrid rice was similar

Grain Quality characteristics of Hybrid Rice

The frequency of rice quality indexes meeting the NY/T 593

index	Indica Conventional rice n=3280		Indica hybrid rice n=2607		Japonica Conventional rice n=2219		Japonica hybrid rice n=284	
	First grade	≧Second grade	First grade	≧Second grade	First grade	≧Second grade	First grade	≧Second grade
BR	17.4	65.9	36.7	87.2	36.0	87.9	46.1	92.3
MR	24.7	65.9	48.4	84.9	17.8	91.9	22.2	74.3
HR	44.4	56.9	52.1	65.1	33.7	55.0	29.9	55.6
CG	16.0	31.8	4.6	15.0	17.3	36.3	17.6	34.5
CD	22.5	42.8	10.9	31.7	16.1	45.2	17.3	39.8
T	19.5	57.7	20.9	72.2	43.0	83.5	40.5	80.1
AV	61.6	82.7	36.6	68.7	92.4	97.5	89.4	94.7
GC	43.0	54.9	32.1	46.9	41.3	72.7	47.5	78.5
AC	15.5	57.8	40.6	75.4	51.2	83.7	65.5	94.0
PC	49.2	77.1	38.6	66.3	39.6	73.6	41.5	72.2

Grain Quality characteristics of Hybrid Rice

- Head rice rate, chalkiness, translucency and gel consistency in hybrid rice remained instable.

Grain Quality characteristics of Hybrid Rice

Grain quality of hybrid rice from 2000-2003

Variety		BR %	MR %	HR %	GL mm	L/W	CG %	CD %	T grade	AV grade	GC mm	AC %	PC %
Shanyou 63	Ave.	81.2	73.5	51.6	6.1	2.4	72.4	16.8	2.4	5.2	62.5	20.8	10.1
n=61	CV	1.0	1.7	16.6	2.5	4.3	21.6	40.7	25.5	10.0	22.7	5.7	11.1
D you 527	Ave.	80.4	72.0	46.1	7.0	3.0	66.9	17.7	2.3	5.4	64.8	21.9	8.4
n=28	CV	1.1	1.9	18.9	3.1	3.5	25.3	55.8	23.6	11.6	20.3	5.7	11.2
Liangyoupei jiu	Ave.	80.5	72.5	53.0	6.6	2.9	44.2	8.2	1.9	5.9	80.1	21.3	9.3
n=36	CV	1.2	2.1	14.3	3.5	4.0	34.1	51.9	31.9	9.5	13.4	5.9	9.7

Conclusion

- The grain quality of indica hybrid rice has made a great progress.
- The Key line is male-sterile line.
- The key grain quality indexes are head rice rate, chalkiness degree, gel consistency and amylose content.
- The grain quality is not the reason that restrict the development of Japonica hybrid rice.

ThANKS !