Discovery of Sichuan apomixis rice and its biological characters

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In the spring of 1988, we discovered some male sterile plants with high seed-setting rates in two lines from the F_7 of cross, Fan 4 / Zhongdan 2 // Zhenshan 97, at Hainan Province, South China. At first, these plants were suspected to be photoperiod sensitive male sterile plants. Through observation in several generations, we found that their offsprings still showed the same characters though the pollens were strictly isolated. The pollens of the materials were checked by I-KI solution and proved to be highly sterile and the percentage of the pollen sterility was over 95%. During anthesis, the anthers usually were not dehiscent. So we suggested that these plants could be a kind of apomixis rice and designated them SAR-1.

To testify the apomictic characters of SAR-1 more exactly, we conducted a strict experiment in a segregated plot. Some selected plants were transplanted into the plot. During anthesis, each floret in selected panicles was emasculated through picking its six anthers out with tweezers carefully and timely when the glumes of the floret just opened. Meanwhile, the every six anthers were stained by I-KI solution, and the sterility and position of each floret in the panicle were recorded. Three weeks later, the seed-setting rates and the seed positions of the panicles were checked again and compared with the former data . The results indicated that the seed-set rate of all sterile panicles were over 15% in average. In addition, two more conventional methods of emasculation, cutting glume and lukewarm water, were used. The emasculated panicles still formed a few seeds under isolation. However, the CK Zhenshan 97, emasculated through these two methods, gave no seeds basically.

The results of the embryological research showed that no pollens were found on stigma when SAR-1 was isolated. Therefore the asexual embryoes may have originated from the reduced eggs, the unreduced eggs and adventitious embryoes. When SAR-1 as a female crossed to other normal male, the outcrossing rate was considerably high (higher than 85%) and the more than 95% of F_1s were real diploid hybrids and the rest were pseudohybrids, indicating that most egg cells were normal and reduced. So we deduced that most of the asexual diploid offsprings of SAR-1 came from the reduced egg cells which were able to double the chromosome number spontaneously under the condition of no fertilization. A genetic experiment had testified this deduction, i.e., some genetic pure lines appeared in F_3 of the crosses between SAR-1 and other parents. Meanwhile, the embryoes which had fully developed before anthesis and the embryoes with abnormal position were observed under microscope. It was proved that some embryoes with abnormal position were originated from ovary wall, too. But the origination of the embryo developed before anthesis was still not clear, and they may come from the unreduced egg cells.

Expression of indica rice resistant sources to Brown Planthopper (BPH) in indica-japonica hybrids and their utilization

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We studied the genetic mode in transferring BPH-resistance genes from indica varieties to japonica varieties January 1988 to December 1989 in Nanjing, Jiangsu Province. Indica varieties selected on a basis of BPH-resistance genes, i.e., Yankeng 2 (japonica), 02428 (japonica), 40316

(indica–japonica progeny), Nanjing 11 (indica) and TN1 (indica) were separately crossed with IR26 (*Bph1*), ASD7 (*bph2*), Rathu Heenati (*Bph3*) and Babawee (*bph4*). Some F_1 hybrids were backcrossed to susceptible parents. The bulk seedling test was used to evaluate the hybrid materials for resistance to BPH.

Indica resistant genes expressed differently in various nuclearcytoplasm backgrounds (see table). When the resistant indica varieties were crossed with TN1, the resistant levels of their progenies to BPH were the same as reported previously by other researchers. The recessive resistant genes (*bph2* and *bph4*) expressed dominantly in F_1 generations which segregated further at 3R : 1S ratio in F_2 populations when the indica varieties were crossed with Nanjing 11.

The reactions of F_1 and F_2 populations from the crosses between indica resistant varieties and japonica varieties to BPH *Nilaparvata lugens*

Cross	F_1 reaction[a]	F_2 reaction (No. of plant)			R: S ratio	X^2
		Total	R	S		
TN1 / IR26	R	141	98	43	3:1	1.99
TN1 / ASD7	S	174	49	125	1:3	0.77
TN1 / Rathu Heenati	R	141	103	38	3:1	0.19
TN1 / Babawee	S	163	33	130	1:3	1.72
Nanjing 11 / IR26	R	196	144	49	3:1	0.17
Nanjing 11 / ASD7	R	148	107	41	3:1	0.44
Nanjing 11 / Rathu Heenati	R	155	113	42	3:1	0.26
Nanjing 11 / Babawee	R	162	128	34	3:1	1.19
Yankeng 2 / IR26	R	114	106	8	15:1	0.02
Yankeng 2 / ASD7	R	190	158	32	13:3	0.34
Yankeng 2 / Rathu Heenati	R	110	75	35	3:1	2.38
Yankeng 2 / Babawee	S	222	102	120	7:9	0.35
02428 / IR26	R	240	221	19	15:1	0.70
02428 / ASD7	R	184	170	14	15:1	0.37
02428 / Rathu Heenati	R	182	165	17	15:1	2.47
02428 / Babawee	R	204	186	18	15:1	1.89
40316 / ASD7	R	143	114	29	13:3	0.13
40316 / Rathu Heenati	R	257	242	15	15:1	0.02
Yankeng 2 / 850041	R	180	79	101	7:9	0.00
Yankeng 2 / 890029	R	281	238	43	13:3	1.97
Yankeng 2 / 874066(IR26)	R	145	131	14	15:1	2.32
Yankeng 2 / 870932(Babawee)	R	144	103	41	8:1	0.75
02428 / 850041	R	217	169	48	13:3	1.49
02428 / 860029	MR	309	143	166	7:9	0.70
02428 / 874066	R	189	149	40	13:3	0.49
850041 / Nanjing 11	R	170	122	48	3:1	0.78
860029 / Nanjing 11	R	184	129	55	3:1	2.09
870932 / Nanjing 11	R	158	128	30	13:1	0.00

[a] R = resistance, S = susceptible, MR = moderate resistance.

Moreover, the resistant levels of the progenies derived from the indica varieties crossed with japonica varieties 02428 and 40316 were strengthened. The reactions of the F_2 hybrids of Yankeng 2 varied when the variety was crossed with different indica varieties. When Yankeng 2, 02428, and Nanjing 11 were crossed with the japonica varieties carrying the resistant genes transferred from the indica varieties, for instance, 850041 derived from IR26, 860029 from ASD7, and 870932 from Babawee, the hybrid progenies segregated at the same ratio as crossed with the resistant indica varieties, indicating that their genetic resistance was stable and could be inherited in the progenies.