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THE ONE HUNDREDTH REPORT OF GENETICAL STUDIES ON RICE PLANT[1)]

— Linkage Studies and Future Prospects —

Toshiro KINOSHITA and Man-emon TAKAHASHI
Plant Breeding Institute, Faculty of Agriculture,
Hokkaido University, Sapporo, 060 Japan
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Preface

Fifty years have passed since the first paper of a serial report contributed on rice genetics was published by the staff members of the Plant Breeding Institute of Hokkaido University[175]. This long-term research entitled "Genetical Studies on Rice Plant" has been continued up to the present through the persistent efforts of the three successive professors, the late Dr. S. NAGAO, Dr. M. TAKAHASHI and Dr. T. KINOSHITA ; the latter two are the writers of the present paper.

Needless to say, rice is the most important staple for mankind. No other crop plant is more adaptive to diversified environments than rice. Among crop plants, rice has genetic diversity unparalleled to other plants familiar to mankind. Rice has been cultivated for a long time and strains have been used as breeding resources in many countries. At the same time, for their more effective utilization it was necessary to explore and record more precisely the genetic nature and the value of genic resources of these varieties and strains.

In Japan the rice plant has been used for genetical studies after the pioneering paper on xenia phenomenon of endosperm character reported in 1902 by Dr. Y. HOSHINO of Sapporo Agricultural College, the forerunner of the present Hokkaido University[44]. Since then a fairly large number of genes has been postulated up to 1940[173,174]. However, it was pointed out that relatively limited information compared with corn and barley was available on gene systems of important characters and on linkage groups at that time.

In this circumstance Dr. NAGAO (then Professor of the Plant Breeding Institute of Hokkaido University) started studies on rice plant, in co-operation with Dr. TAKAHASHI (then Instructor and later Associate Professor) who had just enrolled at the Institute in 1940. This was the beginning of our present long-term

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1) Contribution from the Plant Breeding Institute, Faculty of Agriculture, Hokkaido University, Sapporo 060, Japan.

research activities on rice genetics.

In the span of those fifty years, our interest has grown from genic analysis and linkage relationships to many other genetic problems with them.

The present paper is the 100th report of our activities. As the first report[175] was written in 1941, this 100th report is a product of our fifty years of research on rice plant, and for us this is the an occasion for celebration.

Report 1 to Report 20 were the joint works of Dr. NAGAO and Dr. TAKAHASHI, from Report 21 to Report 30, Dr. KINOSHITA (then Instructor of the Institute) joined the team, and from Report 30 to Report 80, Dr. TAKAHASHI (then Professor) and Dr. KINOSHITA (then Associate Professor) made their efforts to carry on further studies.

Since 1981, Dr. KINOSHITA became Professor of the Institute and he has continued largely along these line of studies and expanded it to incorporate molecular and cell biological aspects. Dr. TAKAHASHI (Professor Emeritus of the University), after his retirement, took up the position of Director of Hokkaido Green-Bio Institute, where he fortunately could keep in touch with further studies on rice genetics and take charge of rice breeding by means of so-called biotechnological approach. On the occasion of the year of his retirement from Hokkaido University, the 80th report was written with regard to current information on gene analysis and its related problems important at that time[296]. This report was published in 1982.

In and after 1981, Dr. KINOSHITA, as the Head of the Institute, presented about twenty reports in this series, together with many others on plant genetics and breeding. Therefore a lot of intriguing information and research themes have been obtained in the course of these studies.

Recently the rearrangement of technology in plant breeding seems to have been undergoing a change with the positive incorporation of cell, chromosome and gene manipulation. The utiilzation of these breeding techniques is actively taking place, and rice plant is coming into focus as the most important target.

With this at the back of our minds, we prepared the 100th report in a comprehensive form of linkage studies and their future problems.

Before coming to the end of the preface, we wish to acknowledge that our study has been greatly assisted by several persons who were or have been staff members or graduate students of the Plant Breeding Institute of Hokkaido University. We take this opportunity to thank them for their excellent collaboration.

Linkage maps

Since a trial construction of 12 linkage groups in rice by NAGAO and TAKAHASHI[177], a wealth of data has been accumulated on the linkage relations in rice, among which, an effort to establish the association between the linkage

groups and the respective chromosomes is worthy of special attention. Following the translocation analyses[68,69,249,250] and their revisions[116,252,354], the relationships among trisomics, chromosomes and linkage groups have been established in both Japonica and Indica rice[73,102]. Because different systems of numbering chromosomes had been used for linkage groups and chromosomes, the Rice Genetics Cooperative, newly organized in 1985, established a unified numbering system depending on the co-operative observations about the extra chromosomes in a series of IR36 trisomics[107,135]. In the concluding session of the 2nd International Rice Genetics Symposium hold in 1990 the new system of chromosome numbering throughout linkage groups, trisomics and karyotypes as shown in Table 1., was accepted by all participants.

Tadle 1. New chromosome numbering system and its comparison with old systems

New system agreed	Linkage groups	Trisomics		Chromosomes	Trans-locations
	Kinoshita (1984)	Khush *et al.* (1984)	Iwata & Omura (1975, 1984)	Kurata *et al.* (1981)	Nishimura (1961)
1	III	1	O	K1	3
2	X	2	N	K2	8
3	XI+XII	4	M	K3	5
4	II	12	E	K4	11
5	VI+IX	5	L	K9	2
6	I	3	B	K6	6
7	IV	7	F	K11	10
8	*sug*	8	D	K7	12
9	V, VII	9	H	K10	1
10	*fgl*	10	C	K12	7
11	VIII	11	G	K8	9
12	*d-33*	6	A	K5	4

Construction of current linkage maps are presented as shown in Fig. 1 and Table 2. The up-to-date information on the recombination frequencies, which include the unlocated genes belonging to each group are shown in the table. Thus, about 206 genes were alloted to the twelve groups and 142 marker genes were positioned on chromosomes.

Gene symbolization

As for rice gene symbolization, there were several earlier proposals[174]. Following this, IBPGR-IRRI Rice Advisory Committee (IRC) showed the rules and listed the gene symbols recommended[19]. After that, the Rice Genetics Cooperative decided the new rules[100] and listed the gene symbols according to the rules as shown in Table 3. There is another table classified due to the different traits (Table 4). There still exist several problems about the naming and several

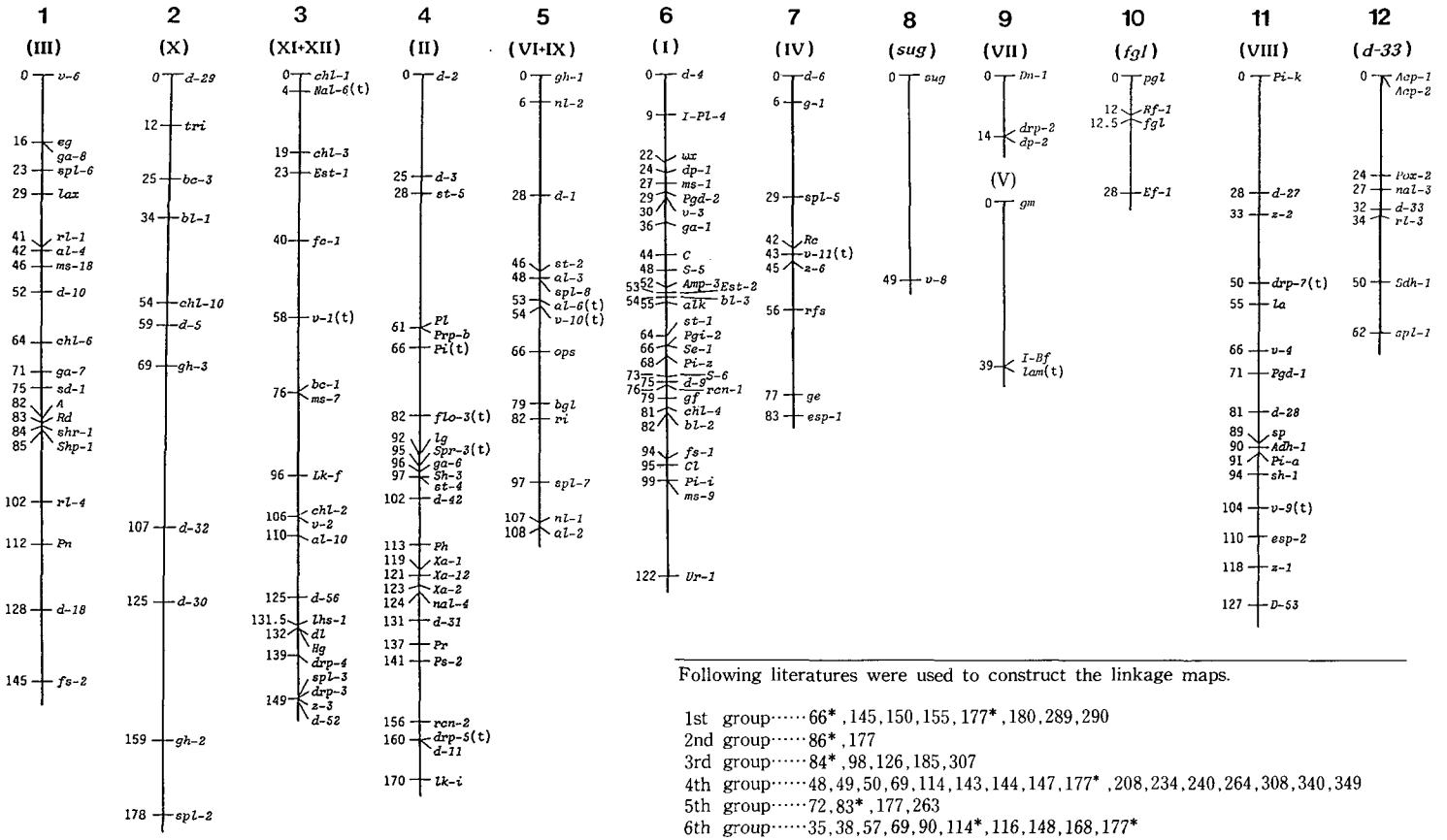

Fig. 1.
Current linkage maps.
Parenthesis means the old numbering system.

Following literatures were used to construct the linkage maps.

1st group……66*, 145, 150, 155, 177*, 180, 289, 290
2nd group……86*, 177
3rd group……84*, 98, 126, 185, 307
4th group……48, 49, 50, 69, 114, 143, 144, 147, 177*, 208, 234, 240, 264, 308, 340, 349
5th group……72, 83*, 177, 263
6th group……35, 38, 57, 69, 90, 114*, 116, 148, 168, 177*
7th group……75, 80, 146, 177*, 259, 263, 288, 367
8th group……102*
9th group……68*, 104, 245*
10th group……254*, 274
11th group……35, 76*, 168, 259, 263
12th group……64*, 102*, 288, 367

* Key literatures.

Table 2. List of marker genes belonging to the linkage group

Gene	Name	Gene locus	Institution*	Reference
Group 1				
v-6	virescent-6	0	KY	66, 78
eg	extra glume	16	KY	66, 68, 75
ga-8	gametophyte gene-8	16	HK	183
spl-6	spotted leaf-6	23	KY	66, 75, 77, 354
lax (*lx*)	lax panicle	29	HK, KY	66, 68, 75, 177
rl-1	rolled leaf-1	41	HK	92, 180
al-4	albino-4	42	KY	66, 72
ms-18	male sterile-18	46	KT	289
d-10 (*d-15, d-16*)	kikeibanshinriki or toyohikari-ibunwai tillering dwarf	52	KY, HK	66, 68, 298
chl-6	chlorina-6	64	KY	66, 78
ga-7	gametophyte gene-7	71	HK	143, 150
sd-1 (*d-47*)	dee-geo-woo-gen dwarf	75	NA, HK	4, 103, 290
A	Anthocyanin activator	82	HK, KY	105, 162, 177
Rd	Red pericarp and seed coat	83	HK, KY	177, 300
shr-1	shrunken endosperm-1	84	KY	155, 260, 342
Shp-1	Sheathed panicle-1	85	HK	92, 145
rl-4 (*rl-2*)	rolled leaf-4	102	HK	71, 73, 155
Pn	Purple node	112	HK, KY	66, 105, 177
d-18 (*d-25*)	hosetsu dwarf (*d-18*^{h}) or kotaketamanishiki dwarf (*d-18*^{k})	128	KY, HK	66, 73, 117, 272
fs-2	fine stripe-2	145	HK, KY	66, 78, 299
Unlocated genes				
al-8	albino-8	11%-*d-18*	KY	66, 72, 78
chl-5	chlorina-5	13%-*eg*	KY	66, 78
d-26 (t)	7237 dwarf	37%-*A*	-	46, 48
d-54 (*d-K-5*)	dwarf-Kyushu-5	25%-*lax*	KY	66, 78
d-55 (*d-K-6*)	dwarf-Kyushu-6	13%-*eg*	KY	66, 78
Est-5	Esterase-5	triplo-1	IR	337
ga-9	gametophyte gene-9	1.3%-*d-18*	HK	150
Got-1	Aspartate aminotransferase-1	triplo-1	IR	337
Icd-1	Isocitrate dehydrogenase-1	triplo-1	IR	337
I-Ps-b	Inhibitor for purple stigma	linked with *A*	-	47
lgt	long twisted grain	16%-*d-26* (t)	-	46
mp-1	multiple pistil-1	triplo-1	IR	141
Prp-a (*Pp*)	Purple pericarp	7.2%-*A*	HK	49, 227
sh-2	shattering-2	11%-*sd-1*	TS	192
ts-a	twisted stem	23%-*A*	-	46
Group 2				
d-29 (*d-K-1*)	short uppermost internode dwarf	0	KY, HK	71, 73, 85, 86
tri	triangular hull	12	KY, HK	69, 73, 85
bc-3	brittle culm-3	25	KY	71, 85
bl-1	brown leaf spot-1	34	HK, KY	85, 86, 177

chl-10	chlorina-10	54	KY	85, 86
d-5	bunketsu-waito tillering dwarf	59	HK	177
gh-3	gold hull and internode-3	69	KY	67, 71, 85
d-32 (*d-12, d-K-4*)	dwarf Kyushu-4	107	KY	67, 85, 86
d-30 (*d-W*)	waisei-shirasasa dwarf	125	KY, HK	69, 85, 86
gh-2	gold hull and internode-2	159	KY, HK	69, 75, 85
spl-2 (*bl-3*)	spotted leaf-2	178	KY	75, 85, 86
Unlocated genes				
Amp-1	Aminopeptidase-1	triplo-2	IR	337
Got-3	Aspartate aminotransferase-3	triplo-2	IR	222, 359
ms-17	male sterile-17	35%-*gh-2*	KT	125, 126
Pi-b (*Pi-s*)	*Pyricularia oryzae* resistance -b	5.8%-TR2-10	NA	123, 277
Group 3				
chl-1	chlorina-1	0	KY	69, 71, 213
Nal-6 (t)	Narrow leaf-6	4	KY	84
chl-3	chlorina-3	19	KY	213
Est-1	Esterase-1	23	NA, IR	36, 182, 185, 222
fc-1	fine culm-1	40	KY	67, 71, 213
v-1 (t)	virescent-1	58	KY	71, 213
bc-1	brittle culm-1	76	HK, KY	177
ms-7	male sterile-7	76	KT	125, 126
Lk-f	'Fusayoshi' long grain	96	HK, OK	302, 307, 311
chl-2	chlorina-2	106	KY	73, 77, 213
v-2	virescent-2	106	KY	73, 79, 213
al-10	albino-10	110	KY	79, 84
d-56 (*d-K-7*)	dwarf Kyushu-7	125	KY	79, 84
lhs-1 (*lhs-2, op*)	leafy hull sterile-1	131.5	KY, IR	45, 98, 100, 115
dl (*lop*)	drooping leaf	132	KY, HK	69, 75, 163
Hg	Hairy glume	132	HK	100, 177, 178
drp-4	dripping-wet leaf-4	139	KY	79, 84
spl-3 (*bl-14*)	spotted leaf-3	149	KY	71, 75, 84
drp-3	dripping-wet leaf-3	149	KY	79, 80, 84
z-3	zebra-3	149	KY	77, 79, 84
d-52 (*d-K-2*)	dwarf Kyushu-2	149	KY	76, 77, 79, 84
Unlocated genes				
An-3	Awn-3	38%-*bc-1*	HK	177, 243
bl-4	brown leaf spot-4	29%-*bc-1*	HK	299
d-14 (*d-10*)	kamikawa-bunwai tillering dwarf	32%-*dl*	HK	298
ga-2	gametophyte gene-2	11%-*dl*	NA, KY	181, 187
ga-3	gametophyte gene-3	34%-*dl*	NA, KY	181, 187
Gdh-1	Glutamete dehydrogenase-1	8%-*Pgi-1*	GI	63, 168
Mi	Minute grain	24%-*Lk-f*	HK	302, 310
Pgi-1	Phosphoglucose isomerase-1	27%-*chl-1*	IR, GI	63, 222, 226
Pox-3	Peroxidase-3	5%-*Pox-4*	IR	222
Pox-4	Peroxidase-4	31%-*Est-1*	IR	222
rl-5 (*rl-3*)	rolled leaf-5	13%-*chl-1*	KY	79

s-e-1	hybrid sterility-e	16%-*bc-1*	GI	206
Shp-4 (Gb)	Sheathed panicle-3	27%-*bc-1*	HK	43
st-3 (stl)	stripe-3	1.1%-*bc-1*	KY	79
v-5	virescent-5	2.0%-*chl-1*	KY	213
v-7	virescent-7	1.7%-*bc-1*	KY	79
Group 4				
d-2	ebisu dwarf	0	HK, KY	177
d-3	bunketsu-waito tillering dwarf	25	HK	177
st-5	stripe-5	28	HK	147
Pl	Purple leaf	61	HK, KY	105, 110, 177, 179
Prp-b (Pb)	Purple pericarp	61	-	49, 227
Pi (t)	*Pyricularia oryzae* resistance	66	-	48
flo-3 (t)	floury endosperm-3	82	HK	144
lg	liguleless	92	HK, KY	177
Spr-3 (t)	Spreading panicle-3	95	GI	240
ga-6	gametophyte gene-6	96	HK	143, 151
Sh-3	Shattering-3	97	GI	240
st-4 (ws-2)	stripe-4	97	HK	143
d-42	liguleless dwarf	102	HK	50, 111
Ph=Bh-c (Po)	Phenol staining	113	HK, KY, GI	138, 143, 177
Xa-1 (Xe)	*Xanthomonas campestris* pv. *oryzae* resistance-1	119	NA	195, 234, 339, 340
Xa-12 (Xa -kg)	*Xanthomonas campestris* pv. *oryzae* resistance-12	121	NA	195, 339, 340
Xa-2	*Xanthomonas campestris* pv. *oryzae* resistance-2	123	NA	23, 234
nal-4 (nal)	narrow leaf-4	124	-	349
d-31	taichung-155 irradiated dwarf	131	-	349
Pr	Purple hull	137	HK, KY	105, 177
Ps-2	Purple stigma-2	141	GI	46, 47, 208
rcn-2	reduced culm number-2	156	HK	308
drp-5 (t)	dripping-wet leaf-5	160	KY	262, 264
d-11 (d-8)	shinkane-aikoku or norin-28 dwarf	160	KY, HK	69, 177
lk-i	'IRAT 13' long grain	170	HK	114, 306
Unlocated genes				
al-5	albino-5	34%-*lg*	KY	72
al-7	albino-7	31%-*lg*	KY	72
An-1	Awn-1	5.4%-*d-11*	HK	177
aul	auricleless	triplo-4	IR	141
Bph-1	Brown planthopper resistance -1	trisomic-4	NA, IR	54, 56, 281
bph-2	brown planthopper resistance -2	39%-*d-2* close to *Bph-1*	NA, IR	54, 56, 281
drp-1	dripping-wet leaf-1	39%-*d-2*	HK	180
drp-8 (t)	dripping-wet leaf-8	28%-*lg*	KY	264
ga-10 (t)	gametophyte gene-10	27%-*lg*	HK	112
nal-1	narrow leaf-1	25%-*d-2*	NA, HK	163
nal-5 (nal-1)	narrow leaf-5	9.5%-*lg*	KY	67, 71
P	Purple apiculus	2.7%-*Pl*	HK	105, 162, 177

Pin-1	Purple internode-1	31%-*Pl*	HK	165
Ps-1	Purple stigma-1	linked to *Ph*	GI	47, 208, 295
rk-1	round kernel-1	35%-*lg*	KY, HK	70, 71, 73
rl-2	rolled leaf-2	35%-*d-2*	HK	163
s-c-2	hybrid sterility-c	31%-*Ph*	GI	205
s-e-2	hybrid sterility-e	15%-*lg*	GI	206
Sc-1	*Sclerotium oryzae* resistance	26%-*lg*	NA	41
spr-1	spreading panicle-1	27%-*Pl*	HK	113
Wh	White hull	8.0%-*lg*	HK	89, 177
Xa-14	*Xanthomonas campestris* pv. *oryzae* resistance-14		NA	315
ylm	yellow leaf margin	10%-*lg*	KY	71, 73
z-5	zebra-5	11%-*lg*	HK	112
Group 5				
gh-1	gold hull and internode-1	0(?)	HK, KY	84, 176, 177
nl-2	neck leaf-2	6	KY	71, 83
d-1	daikoku dwarf	28	HK, KY	83, 177
st-2 (gw)	stripe-2	46	HK	177
al-3	albino-3	48	KY	72, 83
spl-8 (bl-8)	spotted leaf-8	48	KY	75, 83
al-6 (t)	albino-6	53	KY	72
v-10 (t)	virescent-10	54	KY	263
ops	open hull sterile	66	KY	68, 73, 83
bgl	bright green leaf	79	KY	73, 80, 83
ri	verticillate rachis	82	HK, KY	68, 83, 177
spl-7	spotted leaf-7	97	KY	75, 77, 83
nl-1	neck leaf-1	107	HK, KY	83, 177, 252
al-2	albino-2	108	KY	72, 75, 83
Unlocated genes				
An-2	Awn-2	33%-*gl-1*	HK	177, 244
bd-1	beaked lemma	22%-*gl-1*	-	159, 244
er (o)	erect growth habit	38%-*gh-1*	HK	299
eui	elongated uppermost internode	27%-*nl-1*	HK	141, 149, 152, 231
flo-1	floury endosperm-1	12%-*spl-8*	KY	261, 368
gl-1	glabrous leaf and hull	12%-TR1-5d	HK, KY	73, 177, 252
Glh-6	Green leafhopper resistance-6	tripro-5	IR	319
I-Pl-1	Inhibitor for purple leaf-1	31%-*gh-1*	HK	177
M-Pox-1	Modifier for *Pox-1*	close to *gl-1*	CH	214, 216
ms-14	male sterile-14	11%-*nl-1*	KT	124, 125
Pox-1	Peroxidase-1	38%-*nl-1*	CH	216
Shp-3 (Ga)	Sheathed panicle-3	37%-*nl-1*	-	43
xa-5	*Xanthomonas campestris* pv *oryzae* resistance-5	trisomic-5 close to *gl-1*	IR	221, 284, 355
xa-13	*Xanthomonas campestris* pv *oryzae* resistance-13	linked to *xa-5*	IR	199, 233
ylb	yellow banded leaf blade	32%-*nl-1*	-	47
Group 6				
d-4	bunketsu-waito tillering dwarf	0	HK	177
I-Pl-4	Inhibitor for purple pericarp	9	HK	114, 179

wx(am)	glutinous endosperm	22	HK, KY	177, 236, 258
dp-1	depressed palea-1	24	HK, KY	69, 172
ms-1	male sterile-1	27	-	38
Pgd-2	Phosphogluconate dehydrogenase-2	29	GI	60, 168
v-3	virescent-3	30	KY	213
ga-1	gametophyte gene-1	36	KY	74
C	Chromogen for anthocyanin	44	HK	105, 162, 177
S-5	Hybrid sterility-5	48	NA	57
Amp-3 (Amp-1)	Aminopeptidase-3	52	GI	222, 242
Est-2	Esterase-2	53	NA	182, 184, 186, 222
bl-3	brown leaf spot-3	54	HK	299
alk	alkali degeneration	55	KY, NA	128
st-1(ws)	stripe-1	64	KY, HK	172
Pgi-2	Phosphoglucose isomerase-2	66	GI	222, 242
Se-1(Lf, Lm, Rs)	Photosensitivity-1	66	NA	128, 351, 352, 353
Pi-z	*Pyricularia oryzae* resistance-z	68	NA	35, 121, 123, 277
S-6	Hybrid sterility-6	73	GI	238
d-9	Chinese dwarf	75	HK	114
rcn-1	reduced culm number-1	76	HK	303
gf	gold furrows of hull	79	HK	90
chl-4	chlorina-4	81	KY	73, 213
bl-2(bl-m)	brown leaf spot-2	82	HK	89, 180
fs-1(fs)	fine stripe-1	94	HK	116, 177
Cl	Clustered spikelets	95	HK	89, 177
Pi-i	*Pyricularia oryzae* resistance-i	99	NA	35, 123, 277
ms-9	male sterile-9	99	KT	125, 246
Ur-1(Ur)	Undulated rachis-1	122	HK	177
Unlocated genes				
al-1	albino-1	7.1%-*wx*	KY	72
al-9 (t)	albino-9	trisomic-6	KY	80
aph	apiculus hairs	linked to *Est-2* and *Pgi-2*	GI	255, 256
bc-4	brittle culm-4	triplo-6	IR	141
Cat-1	Catalase-1	22%-*Pox-5*	IR, GI	63
chl-7 (t)	chlorina-7	27%-*Pi-z*	NA	141, 211
d-21	aomorimochi-14 dwarf	8.3%-*wx*	HK	117
drp-6 (t)	dripping-wet leaf-6	15%-*fc-2* (t)	KY	262, 264
dw-1(fh)	deep water tolerance	30%-*Se-1*	NA	88, 225
En-Se-1 (t)	Enhancer for photosensitivity (*Se-1*)	6%-*wx*	GI	367
Enp-1	Endopeptidase-1	2.2%-*Cat-1*	IR	222
fc-2 (t)	fine culm-2	18%-*C*	KY	262, 264
ga-4(ga-A)	gametophyte gene-4	34%-*wx*	HK, KY	164, 188
ga-5(ga-B)	gametophyte gene-5	27%-*wx*	HK	164
Got-2	Aspartate aminotransferase-2	31%-*Pgi-2*	GI, IR	222
Hl-a	Hairy leaf	21%-*fs-1*	HK	177, 178, 365

I-Pl-2	Inhibitor for purple leaf-2	10%-*I-Pl-4*	HK	114, 179
mp-2	multiple pistil-2	triplo-6	IR	141
Pox-5	Peroxidase-5	39%-*Pgi-2*	IR, GI	337
S-1	*Hybrid sterility-1*	*close to C*	GI	241
s-a-1(s_1, x_1)	hybrid sterility-a	21%-*wx*	GI	202, 206
s-c-1	hybrid sterility-c	8.6%-*C*	GI	205
s-d-1	hybrid sterility-d	33%-*wx*	GI	206
S-A-1(*A-1*)	Hybrid sterility-A	9.5%-*C*	GI	209
S-B-2(*B-2*)	Hybrid sterility-B	28%-*wx*	GI	207, 209
spl-4(*bl-15*)	spotted leaf-4	2.5%-*dp-1*	KY	71, 73, 75
Stv-a(*St*)	Stripe disease resistance-a	38%-*wx*	NA	332, 333
Un-a	Uneven grain	22%-*Cl-a*	-	318
v-1	virescent-1	25%-*C*	HK	87, 88, 177
zn	zebra necrosis	20%-*C*	HK	112
Group 7				
d-6	ebisumochi or tankanshira-sasa dwarf	0	HK, KY	177
g-1	long sterile lemmas-1	6	HK, KY	177
spl-5(*bl-6*)	spotted leaf-5	29	KY	71, 75
Rc	Brown pericarp and seed coat	42	HK, KY	177, 300
v-11(t)	virescent-11	43	KY	263
z-6	zebra-6	45	HK	146
rfs	rolled fine striped leaf	56	HK, KY	73, 80
ge	giant embryo	77	KY, HK	73, 260, 343, 368
esp-1(*rsp-1*)	endosperm storage protein-1	83	KY	130, 131, 132, 259
Unlocated genes				
β-Amy-1(t)	β-amylase isozyme-1	trsomic-7	KY	278
d-7	heiei-daikoku or cleisto-gamous dwarf	39%-*d-6*	HK	177
d-60	dwarf (Hokuriku 100)	trisomic-7	KT	312
Est-9(*Est-cl*)	Esterase-9	triplo-7	GI, IR	222, 226, 242
lp-1	long palea-1	12%-*Un-b*	-	316, 318
Mal-1	Malate dehydrogenase (NADP)-1	linked to RG 173	IR	359
m-Ef-1	*modifier for Ef-1*	*23%-Rc*	*CH*	324, 325
ms-8	male sterile-8	20%-*rfs*	KT	125, 126
rl-6(t)	rolled leaf-6	12%-*lp-1*	-	316
se-2	photosensitivity-2	23%-*g-1*	-	357
Un-b	Uneven grain	18%-*g-1*	-	318
Group 8				
sug(*su*)	sugary endosperm	0	KY	65, 102, 260, 261
v-8	virescent-8	49	KY	73, 81, 102
Unlocated genes				
Amp-2	Aminopeptidase-2	trisomic-8	GI, IR	61, 63, 222, 337
Amp-4	Aminopeptidase-4	triplo-8	IR	337
An-4(t)	Awn-4	5.0%-TR7-8b	RY	248
chl-8	chlorina-8	triplo-8	IR	97
chl-9	chlorina-9	triplo-8	IR	97
d-51(*d-K-8*)	dwarf Kyushu-8	trisomic-8	KY	73, 81
shr-2	shrunken endosperm-2	trisomic-8	KY	156, 258, 342

Stv-b (*St-2*)	Stripe disease resistance-b	linked to TR1-8	NA	332, 333
ur-2	undulate rachis-2	trisomic-8	KY	73, 81
z-4	zebra-4	trisomic-8	KY	73, 81
Group 9				
Dn-1	Dense panicle-1	0	HK, KY	68, 177
drp-2	dripping-wet leaf-2	14	KY	68, 262
dp-2	depressed palea-2	14	HK, KY	68, 163
gm (*pd, sgm*)	gall midge resistance	0	-	245, 269
I-Bf	Inhibitor for brown furrows	39	HK, KY	73, 176, 177, 245
lam (t)	low amylose endosperm	39	HK	104
Unlocated genes				
Bp	Burlush-like panicle	trisomic-9	KY	70, 73
chs-1 (t)	chlorosis caused by low temperature (17°C)	27%-*dp-2*	KY	360
d-57 (*d* (*x*))	dwarf	21%-*Dn-1*	-	48, 348
Est-3	Esterare-3	16%-257	NA	185, 347
ms-10	male sterile-10	5%-*Dn-1*	KT	124, 125
Pi-ta (=*sl*)	*Pyricularia oryzae* resistance-ta	4.5%-TR9-12	NA	122, 123, 277
Group 10				
pgl	pale green leaf	0	KY	70, 274, 354
Rf-1	Pollen fertility restoration-1	12	RY, HK, NA	73, 273, 274, 275
fgl (*fl*)	faded green leaf	12.5	KY	70, 274, 354
Ef-1 (=*Ef-2*)	Earliness-1	28	RY, CH	253, 254, 324, 326
Unlocated genes				
Bph-3	Brown planthopper resistance -3	trisomic-10	NA, IR	54, 140, 281
bph-4	brown planthopper resistance -4	30%-*rk-2* close to *Bph-3*	NA, IR	54, 140, 281, 282
d-20	hayayuki dwarf	triplo-10	HK	100, 102, 117
du-1	dull endosperm-1	trisomic-10	KY	73, 212, 260, 345
Glh-3	Green leafhopper resistance-3	34%-*bph-4*	IR	6, 282, 288
rk-2	round kernel-2	2.5%-TR10-11	KY	73, 354
ygl	yellow green leaf	triplo-10	IR	141
Group 11				
Pi-k	*Pyricularia oryzae* resistance-k	0	NA	35, 123, 277
d-27 (*d-t*)	bunketsuto tillering dwarf	28	KY, HK	71, 76
z-2	zebra-2	33	KY	71, 76
drp-7 (t)	dripping-wet leaf-7	50	KY	262, 264
la	lazy growth habit	55	HK, KY	76, 177
v-4	virescent-4	66	KY	76, 77, 213
Pgd-1	Phosphogluconate dehydrogenase-1	71	GI, IR	62, 63, 222, 337
d-28 (*d-C*)	chokeidaikoku or long stemmed dwarf	81	KY	76
sp	short panicle	89	KY, HK	69, 71, 76
Adh-1	Alcohol dehydrogenase-1	90	IR	60, 63, 226
Pi-a	*Pyricularia oryzae* resistance -a	91	NA	35, 123, 277

sh-1	shattering-1	94	HK	177
v-9 (t)	virescent-9	104	KY	263
esp-2 (*rsp-2*)	endosperm storage protein-2	110	KY	131, 132, 259
z-1	zebra-1	118	KY	70, 71, 73
D-53 (*D-K-3*)	Dwarf Kyushu-3	127	KY	73, 76, 77
Unlocated genes				
esp-3 (*rsp-3*)	endosperm storage protein-3	trisomic-11	KY	129, 130
Fdp-1	Fructose-1,6-diphosphatase-1	triplo-11	IR	229, 359
lt (t)	gametic lethal	24%-*la*	KT	312, 370
M-Pi-z	Modifier for *Pi-z*	11%-*la*	YA	32
nal-2	narrow leaf-2	36%-*la*	HK	163
Pi-f	*Pyricularia oryzae* resistance-f	15%-*Pi-k*	NA	277, 321, 358
Pi-se-1 (*Rb-1*)	*Pyricularia oryzae* resistance -se	9.5%-*la*	YA	31, 33
Pi-is-1 (*Rb-4*)	*Pyricularia oryzae* resistance -is	23%-*la*	YA	31
S-3	Hybrid sterility-3	1%-*la*	IR	235
Xa-3 (*Xa-w*, *Xa-4*^{b} *Xa-6* *Xa-9*)	*Xanthomonas campestris* pv. *oryzae* resistance-3	22%-*d-27*	IR	23, 196, 198, 200, 201, 280, 286
Xa-4 (*Xa-4*^{a})	*Xanthomonas campestris* pv. *oryzae* resistance-4	close to *Xa-3* (tripro-7?)	IR	197, 221, 292
Xa-10	*Xanthomonas campestris* pv. *oryzae* resistance-10	27%-*Xa-4*	IR	356
Group 12				
Acp-1	Acid phosphatase-1	0	IR, GI	36, 60, 64, 337
Acp-2	Acid phosphatase-2	0	IR, GI	36, 63, 222, 337
Pox-2	Peroxidase-2	24	GI	36, 60, 63, 64, 222, 337, 364
nal-3 (*nal-2*)	narrow leaf-3	27	KY, HK	70, 73, 168, 354
d-33 (*d-B*)	bonsaito dwarf	32	KY	70, 73, 168, 364
rl-3 (*rl-1*)	rolled leaf-3	34	KY, IR	70, 102, 168, 354, 364
Sdh-1	Shikimate dehydrogenase-1	50	IR	36, 63, 222, 226, 364
spl-1 (*bl-12*)	spotted leaf-1	62	KY	70, 75, 102, 354
Unlocated genes				
du-4	dull endosperm-4	trisomic-12	KY	258, 345

Institution code :

CH : Food Crops Research Institute, National Chung Hsing University, Taichung, Taiwan 400, ROC

GI : Genetic Stock Research Center, National Institute of Genetics, Misima, 411 Japan

HK : Plant Breeding Institute, Faculty of Agriculture, Hokkaido University, Kita 9, Nishi 9, Sapporo, 060 Japan

IR : Rice Germplasm Center, International Rice Research Institute, P. O. Box 933, Manila, Philippines

KT : Plant Breeding Laboratory, Faculty of Agriculture, Kyoto University, Kitashirakawa, Sakyou-ku, Kyoto, 606 Japan.

KY : Plant Breeding Laboratory, Faculty of Agriculture, Kyushu University, Hakozaki, Fukuoka, 812 Japan

NA : Gene plasm storage center, National Institute of Agrobiological Resources, Tsukuba, 305 Japan
OK : Institute for Agricultural and Biological Sciences, Okayama University, Kurashiki, 710 Japan
RY : Plant Breeding Laboratory, College of Agriculture, University of Ryukyus, Senbaru, Nishihara-cho, Okinawa, 903-01 Japan
TS : Dr. F. Kikuchi, Institute of Agriculture and Forestry, University of Tsukuba, Tennodai 1-1-1, Tsukuba, 305 Japan
UA : Dr. J. Neil. Rutger, USDA-ARS, Mid South Area, P. O. Box 225, Stoneville, MS. 38776, U. S. A.
YA : Dr. T. Sasahara, College of Agriculture, Yamagata University, Tsuruoka, 997 Japan

Table 3. List of Gene Symbols (**Linkage group** and key literature)

A	Anthocyanin activator / A^s, A^e, A^d, A^m (**1**, NAGAO & TAKAHASHI 1963)
Acp-1	Acid phosphatase-1 / $Acp\text{-}1^0$, $Acp\text{-}1^1$ ($Acp\text{-}1^{-4}$), $Acp\text{-}1^2$ ($Acp\text{-}1^{+9}$), $Acp\text{-}1^3$ ($Acp\text{-}1^{+4}$) (**12**, ENDO 1981, ISHIKAWA *et al.* 1989a, b, WU *et al.* 1988, PHAM *et al.* 1990)
Acp-2	Acid phosphatase-2 / $Acp\text{-}2^0$, $Acp\text{-}2^1$ ($Acp\text{-}2^{Fa}$) (**12**. PAI *et al.* 1975, WU *et al.* 1988, PHAM *at al.* 1990)
Acp-3	Acid phosphatase-3 / (PAI *at al.* 1975, PHAM *et al.* 1990)
Acp-4	Acid phosphatase-4 / $Acp\text{-}4^1$, $Acp\text{-}4^2$ (SECOND 1982, GUIDERDONI *et al.* 1989)
Adh-1	Alcohol dehydrogenase-1 / $Adh\text{-}1^0$, $Adh\text{-}1^1$, $Adh\text{-}1^2$, $Adh\text{-}1^3$ (**11**. RANJHAN *et al.* 1988, ISHIKAWA *et al.* 1989a)
ae-1	amylose extender-1(YANO *et al.* 1985)
ae-2 (t)	amylose extender-2 (KIKUCHI & KINOSHITA 1987)
al-1 (*al-K-1*)	albino-1 (**6**, IWATA & OMURA 1978)
al-2	albino-2 (**5**, IWATA & OMURA 1978)
al-3	albino-3 (**5**, IWATA & OMURA 1978)
al-4	albino-4 (**1**, IWATA & OMURA 1978)
al-5	albino-5 (**4**, IWATA & OMURA 1978)
al-6 (t)	albino-6 (**5**, IWATA & OMURA 1978)
al-7 (t)	albino-7 (**4**, IWATA & OMURA 1978)
al-8	albino-8 (**1**, IWATA & OMURA 1978)
al-9 (t)	albino-9 (**6**, IWATA *et al.* 1981)
al-10	albino-10 (**3**, IWATA *et al.* 1979b)
alk	alkali degeneration (**6**, KUDO 1968)
Am (t)	High amylose (HSIEH & WANG 1989*)
Amp-1 (*Lap-1, Lap-F*)	Aminopeptidase-1 / $Amp\text{-}1^1$, $Amp\text{-}1^2$, $Amp\text{-}1^3$, $Amp\text{-}1^4$, $Amp\text{-}1^5$, $Amp\text{-}1^6$ (**2**, WU *et al.* 1988, PHAM *et al.* 1990)
Amp-2 (*Alap-A*)	Aminopeptidase-2 / $Amp\text{-}2^1$, $Amp\text{-}2^2$, $Amp\text{-}2^3$, $Amp\text{-}2^4$ (8, WU *et al.* 1988, ISHIKAWA *et al.* 1989a, PHAM *et al.* 1990)
Amp-3 (*Amp-1*)	Aminopeptidase-3 / $Amp\text{-}3^0$, $Amp\text{-}3^1$, $Amp\text{-}3^2$, $Amp\text{-}3^3$, $Amp\text{-}3^4$, $Amp\text{-}3^5$, $Amp\text{-}3^6$ (**6**, SANO & BARBIER 1985, PHAM *et al.* 1990)
Amp-4	Aminopeptidase-4 / $Amp\text{-}4^1$, $Amp\text{-}4^2$, $Amp\text{-}4^3$ (8, WU *et al.* 1988)
An-1	Awn-1 / duplicate or triplicate (**4**, NAGAO & TAKAHASHI 1963)
An-2	Awn-2 (**5**, NAGAO & TAKAHASHI 1963)
An-3	Awn-3 (**3**, NAGAO & TAKAHASHI 1963)
An-4 (t)	Awn-4 (8, SATO & TSUKASAKI 1984)

aph	apiculus hairs (**6**, SATO 1985, SATO *et al.* 1987)
as	asynapsis-1 (KATAYAMA 1963)
aul	auricleless (**4**, LIBROJO & KHUSH 1986)
β-Amy-1(t)	β-Amylase isozyme-1 (**7**, SHIRAISHI & SATO 1990)
bc-1	brittle culm-1 (**3**, NAGAO & TAKAHASHI 1963)
bc-2	brittle culm-2 (TAKAHASHI *et al.* 1968)
bc-3	brittle culm-3 (**2**, IWATA & OMURA 1977)
bc-4	brittle culm-4 (**6**, LIBROJO & KHUSH 1986)
bd-1	beaked lemma / duplicate (MISRO 1981)
bd-2	beaked lemma (MISRO 1981)
Bf	Brown furrows of hull (NAGAO & TAKAHASHI 1963)
bgl	bright green leaf (**5**, IWATA *et al.* 1981, 1984b)
Bh-a (*Bh-1*)	Black hull / complementary action of three genes (NAGAO & TAKAHASHI 1954, MAEKAWA 1982)
Bh-b (*Bh-2*)	Black hull (NAGAO & TAKAHASHI 1954, MAEKAWA 1982)
Bh-c(=*Ph*)	Black hull (**4**, NAGAO & TAKAHASHI 1954, KURIYAMA & KUDO 1967)
bl-1	blown leaf spot-1 (**2**, NAGAO & TAKAHASHI 1963)
bl-2 (*bl-m*)	brown leaf spot-2 (**6**, JODON 1957, NAGAO *et al.* 1964)
bl-3	brown leaf spot-3 (**6**, TAKAHASHI *et al.*, 1968)
bl-4	brown leaf spot-4 (**3**, TAKAHASHI *et al.* 1968)
bl-5	brown leaf spot-5 (TAKAHASHI *et al.* 1968)
bl-6	brown leaf spot-6 (TAKAHASHI *et al.* 1968)
Bp	Burlush-like panicle (**9**, IWATA & OMURA 1975)
Bph-1	Brown planthopper resistance-1 (**4**, SIDHU & KHUSH 1978b, IKEDA 1985)
bph-2	brown planthopper resistance-2 (**4**, SIDHU & KHUSH 1978b, IKEDA 1985)
Bph-3	Brown planthopper resistance-3 (**10**, SIDHU & KHUSH 1978b, IKEDA 1985)
bph-4	brown planthopper resistance-4 (**10**, SIDHU & KHUSH 1978b, IKEDA 1985)
bhp-5	brown planthopper resistance-5 (KHUSH *et al.* 1985)
Bph-6	Brown planthopper resistance-6 (KABIR & KHUSH 1988)
bph-7	brown planthopper resistance-7 (KABIR & KHUSH 1988)
bph-8	brown planthopper resistance-8 (NEMOTO *et al.* 1989)
Bph-9	Brown planthopper resistance-9 (NEMOTO *et al.* 1989)
Bsv(*Bs*)	Black streaked dwarf resistance (MORINAKA *et al.* 1969)
bzs	bentazon susceptibility (MORI 1984)
C	Chromogen for anthocyanin / C^{Bs}, C^{B}, C^{Bp}, C^{Bt}, C^{Br}, C^{Bd}, C^{Bk}, C^{Bc}, C^{Bm} (**6**, NAGAO & TAKAHASHI 1963)
Cat-1	Catalase-1 / $Cat\text{-}1^{1}$, $Cat\text{-}1^{2}$, $Cat\text{-}1^{3}$ (**6**, WU *et al.* 1988, ISHIKAWA *et al.* 1989a)
Ce	*Cercospora* resistance (JODON & CHILTON 1946)
chl-1 (*ch-1*)	chlorina-1 (**3**, IWATA & OMURA 1971b, OMURA *et al.* 1978)
chl-2	chlorina-2 (**3**, OMURA *et al.* 1978)
chl-3	chlorina-3 (**3**, OMURA *et al.* 1978)
chl-4	chlorina-4 (**6**, OMURA *et al.* 1978)
chl-5	chlorina-5 (**1**, IWATA *et al.* 1979a)
chl-6	chlorina-6 (**1**, IWATA *et al.* 1979a)
chl-7(t)	chlorina-7 (**6**, OKUNO 1983, LIBROJO & KHUSH 1986)
chl-8	chlorina-8 (**8**, KHUSH & CRUZ 1988)
chl-9	chlorina-9 (**8**, KHUSH & CRUZ 1988)

chl-10	chlorina-10 (**2**, IWATA *et al.* 1989a, b)
chs-1(t)	chlorosis caused by low temperature-1 (17°C) / *chs-1*^{A}, *chs-1*^{B}, *chs-1*^{C} (**9**, CHUONG & OMURA 1982*)
chs-2(t)	chlorosis caused by low temperature-2 (17°C) / *chs-2*^{B}, *chs-2*^{C} (CHUONG & OMURA 1982*)
chs-3(t)	chlorosis caused by low temperature-3 (17°C) (CHUONG & OMURA 1982*)
chs-4(t)	chlorosis caused by low temperature-4 (15°C) (CHUONG & OMURA 1982*)
Cl	Clustered spikelets (**6**, JODON 1957, NAGAO & TAKAHASHI 1963, Pavithran *et al.* 1989*)
clw	claw shaped spikelet (TAKAHASHI *et al.* 1968)
[*cms-bo*]	'Chinsurah boro II' cytoplasm (SHINJO 1975)
[*cms*-UR89]	'UR89F' cytoplasm (SHINJO 1990)
[*cms*-UR102]	'UR102F' cytoplasm (SHINJO 1990)
[*cms*-UR104]	'UR104F' cytoplasm (SHINJO 1990)
[*cms*-UR27]	'UR27F' cytoplasm (SHINJO 1990)
[*cms*-UR106]	'UR106F' cytoplasm (SHINJO 1990)
[*cms-ld*]	'Lead rice' cytoplasm (WATANABE 1971)
[*cms-TA*]	'TA820' cytoplasm (KITAMURA 1962a, b)
[*cms-CW*]	Chinese wild rice cytoplasm (KATSUO & MIZUSHIMA 1958)
[*cms-WA*]	WA-group cytoplasm (CHENG & YUAN 1980)
[*cms-HL*]	HL-group cytoplasm (CHENG & YUAN 1980)
[*cms-ak*] ([*cms-jp*])	'Akebono' cytoplasm (YABUNO 1977)
cps	compact panicle sterile (TAKAHASHI & TATE 1951)
Cts	Cold tolerance at seedling stage (KWAK *et al.* 1984)
D-a(*D-1*)	Dominant lethal / complementary (CHU & OKA 1970)
D-b(*D-2*)	Dominant lethal (CHU & OKA 1970)
d-1	daikoku dwarf (**5**, NAGAO & TAKAHASHI 1963)
d-2	ebisu dwarf (**4**, NAGAO & TAKAHASHI 1963)
d-3	bunketsu-waito tillering dwarf / duplicate or triplicate (**4**, NAGAO & TAKAHASHI 1963)
d-4	bunketsu-waito tillering dwarf (**6**, NAGAO & TAKAHASHI 1963)
d-5	bunketsu-waito tillering dwarf (**2**, NAGAO & TAKAHASHI 1963)
d-6(*d-34*)	ebisumochi dwarf or tankanshirasasa dwarf (**7**, NAGAO & TAKAHASHI 1963)
d-7	heiei-daikoku or cleistogamous dwarf (**7**, NAGAO & TAKAHASHI 1963)
d-9	Chinese dwarf (**6**, KINOSHITA & TAKAMURE 1990)
d-10 (*d-15, 16*)	Kikeibanshinriki or toyohikaribunwai tillering dwarf (**1**, IWATA & OMURA 1971a)
d-11(*d-8*)	shinkane-aikoku or nohrin 28 dwarf (**4**, IWATA & OMURA 1971b)
d-12 =(*d-50*(t))	yukara dwarf or fukei 71 dwarf (FUTSUHARA 1968, TAKAHASHI *et al.* 1968, MURAI *et al.* 1990)
d-13	short grained dwarf (TAKAHASHI *et al.* 1968)
d-14 (*d-10*)	kamikawabunwai tillering dwarf (**3**, TAKAHASHI & KINOSHITA 1974)
d-17(t)	slender dwarf (TAKAHASHI & KINOSHITA 1974)
d-18^{h}	hosetsu-waisei or akibare dwarf / (**1**, KINOSHITA *et al.* 1974) / *d-18*^{k} (*d-25*) kotaketamanishiki dwarf (SHINBASHI *et al.* 1976)
d-19(t)	kamikawa dwarf (KINOSHITA *et al.* 1974)
d-20	hayayuki dwarf (**3**, KINOSHITA *et al.* 1974)
d-21	aomorimochi-14 dwarf (**6**, KINOSHITA *et al.* 1974)
d-22(t)	jokei 6549 dwarf (TAKAHASHI & KINOSHITA 1974)

d-23 (t) ah-7 dwarf (TAKAHASHI & KINOSHITA 1974)
d-24 (t) m-7 dwarf (KINOSHITA & SHINBASHI 1982)
d-26 (t) 7237 dwarf (**1**, HSIEH 1960)
d-27 (*d-t*) bunketsuto tillering dwarf (**11**, IWATA & OMURA 1977)
d-28 (*d-C*) chokeidaikoku or long stemmed dwarf (**11**, IWATA *et al.* 1978b)
d-29 (*d-K-1*) short uppermost internode dwarf (**2**, IWATA & OMURA 1977)
d-30 (*d-W*) waisei-shirasasa dwarf (**2**, IWATA & OMURA 1971b)
d-31 taichung-155-irradiated dwarf (**4**, YEN *et al.* 1968)
d-32 (*d-K-4, d-12*) dwarf Kyushu-4 (**2**, IWATA & OMURA 1970)
d-33 (*d-B*) bonsaito dwarf (**12**, IWATA & OMURA 1975)
d-35 (t) tanginbozu dwarf (SHINBASHI *et al.* 1975, 1976)
d-42 (t) liguleless dwarf (**4**, HSIEH & YEN 1966, KINOSHITA & SHINBASHI 1982)
d-49 (t) reimei dwarf (FUTSUHARA 1968)
d-51 (*d-K-8*) dwarf Kyushu-8 (**8**, IWATA *et al.* 1983)
d-52 (*d-K-2*) dwarf Kyushu-2 (**3**, IWATA *et al.* 1977)
D-53 (*d-K-3*) Dwarf Kyushu-3 (**11**, IWATA *et al.* 1977)
d-54 (*d-K-5*) dwarf Kyushu-5 (**1**, IWATA *et al.* 1979a)
d-55 (*d-K-6*) dwarf Kyushu-6 (**1**, IWATA *et al.* 1979a)
d-56 (*d-K-7*) dwarf Kyushu-7 (**3**, IWATA *et al.* 1979b)
d-57 (*d* (*x*)) dwarf (**9**, YEN & HSIEH 1968)
d-58 (t) small grained dwarf (TAKAMURE & KINOSHITA 1986)
d-59 (t) dwarf (DM107-4) (AWAN & CHEEMA 1988)
d-60 [*sd* (t)] dwarf (Hokuriku 100) (**7**, TOMITA *et al.* 1989*, TANISAKA *et al.* 1990)
Dia-1 (t) Diaphorase-1 / *Dia-1*^{1}(t), *Dia-1*^{2}(t) (REYES *et al.* 1989)
Dia-2 (t) Diaphorase-2 / *Dia-2*^{1}(t), *Dia-2*^{2}(t) (REYES *et al.* 1989)
dl (*lop*) drooping leaf (**3**, IWATA & OMURA 1971b)
Dn-1 (*Dn*) Dense panicle-1 (**9**, NAGAO & TAKAHASHI 1963)
Dn-2 Dense panicle-2 (JONES 1952)
dn-3 dense panicle-3 (FUTSUHARA *et al.* 1979)
dp-1 depressed palea-1 (**6**, NAGAMATSU & OMURA 1962, IWATA & OMURA 1971b)
dp-2 depressed palea-2 (**9**, IWATA & OMURA 1971a)
drp-1 dripping-wet leaf-1 (**4**, NAGAO *et al.* 1964)
drp-2 dripping-wet leaf-2 (**9**, IWATA *et al.* 1971a)
drp-3 dripping-wet leaf-3 (**3**, IWATA *et al.* 1979b)
drp-4 dripping-wet leaf-4 (**3**, IWATA *et al.* 1979b)
drp-5 (t) dripping-wet leaf-5 (**4**, SATOH *et al.* 1983, 1986)
drp-6 (t) dripping-wet leaf-6 (**6**, SATOH *et al.* 1983, 1986)
drp-7 (t) dripping-wet leaf-7 (**11**, SATOH *et al.* 1983, 1986)
drp-8 (t) dripping-wet leaf-8 (**4**, SATOH *et al.* 1986)
ds-1 desynapsis-1 (CHAO & HU 1960, CHAO *et al.* 1960)
ds-2 (t) desynapsis-2 (KITADA & OMURA 1983)
ds-3 (t) desynapsis-3 (KITADA & OMURA 1983)
ds-4 (t) desynapsis-4 (KITADA & OMURA 1983)
ds-5 (t) desynapsis-5 (KITADA & OMURA 1983)
ds-6 (t) desynapsis-6 (KITADA & OMURA 1983)
ds-7 (t) desynapsis-7 (KITADA & OMURA 1983)
ds-8 (t) desynapsis-8 (KITADA & OMURA 1983)

ds-9 (t) desynapsis-9 (KITADA & OMURA 1983)
ds-10 (t) desynapsis-10 (KITADA & OMURA 1983)
ds-11 (t) desynapsis-11 (KITADA & OMURA 1983)
du-1 dull endosperm-1 (**10**, SATOH & OMURA 1986, YANO *et al.* 1988)
du-2 dull endosperm-2 (SATOH & OMURA 1986)
du-3 dull endosperm-3 (SATOH & OMURA 1986)
du-4 dull endosperm-4 (**12**, YANO *et al.* 1988, SATOH & IWATA 1990)
du-5 dull endosperm-5 (YANO *et al.* 1988)
dw-1 (*fh-1*) deep water tolerance / duplicate (**6**, RAMIAH & RAMASWAMI 1941, CHANDRARATNA 1964)
dw-2 (*fh-2*) deep water tolerance (RAMIAH & RAMASWAMI 1941, CHANDRARATNA 1964)
dw-3 (t) deep water tolerance-3 (EIGUCHI & SANO 1990)
E-1 Heading date-1 (SYAKUDO & KAWASE 1953, OKUMOTO *et al.* 1984)
E-2 Heading date-2 (SYAKUDO & KAWASE 1953)
E-3 Heading date-3 (SYAKUDO *et al.* 1954)
Ef-1 (=*Ef-2*) Earliness-1 / *Ef-1*^{a}, *Ef-1*^{b}, *Ef-1*^{t}, *Ef-1*^{x} (**10**, TSAI & OKA 1966, TSAI 1976, SATO & SHIRAKAWA 1986, SATO *et al.* 1988)
eg extra glume (**1**, IWATA & OMURA 1971a)
En-Se-1 (t) Enhancer for photosensitivity (*Se-1*) (**6**, SANO 1990b)
Enp-1 Endopeptidase / *Enp-1*^{0}, *Enp-1*^{1} Monomer (**6**, PHAM *et al.* 1990)
er (*o*) erect growth habit (**5**, TAKAHASHI *et al.* 1968)
Esb-a Extra schlenchymatous band in stem / complementary (SETHI & ROY 1984)
Esb-b Extra schlenchymatous band in stem (SETHI & ROY 1984)
esp-1 endosperm storage protein-1 (**7**, KUMAMARU *et al.* 1987, 1990)
esp-2 endosperm storage protein-2 (**11**, KUMAMARU *et al.* 1987, 1990)
esp-3 endosperm storage protein-3 (**11**, KUMAMARU *et al.* 1987, 1989, 1990)
Esp-4 Endosperm storage protein-4 (KUMAMARU *et al.* 1988, 1990)
Est-1 Esterase-1 / *Est-1*^{0}, *Est-1*^{1} (*Est-1*^{S}) (**4** or **7**? NAKAGAHRA 1977, 1990, GUIDERDONI *et al.* 1989, PHAM *et al.* 1990)
Est-2 Esterase-2 / *Est-2*^{0}, *Est-2*^{1} (*Est-2*^{S}), *Est-2*^{2} (*Est-2*^{F}) (**6**, NAKAGAHRA & HAYASHI 1976, NAKAGAHRA 1984)
Est-3 Esterase-3 / *Est-3*^{1} (*Est-3*^{S}), *Est-3*^{2} (*Est-3*^{F}) (**9**, NAKAGAHRA 1977*, PHAM *et al.* 1990, Yano et al. 1990)
Est-4 Esterase-4 / *Est-4*^{1} (*Est-4*^{S}), *Est-4*^{2} (*Est-4*^{F}) (SECOND 1982)
Est-5 Esterase-5 / *Est-5*^{0}, *Est-5*^{1}, *Est-5*^{2} (**1**, WU *et al.* 1988, PHAM *et al.* 1990)
Est-6 Esterase-6 / *Est-6*^{0}, *Est-6*^{1}, *Est-6*^{2} (SECOND 1982, PHAM *et al.* 1990)
Est-7 Esterase-7 / *Est-7*^{0}, *Est-7*^{1} (SECOND 1982, GUIDERDONI *et al.* 1989)
Est-8 Esterase-8 / *Est-8*^{0}, *Est-8*^{1} (SECOND 1982, PHAM *et al.* 1990)
Est-9 (*Est-cl*) Esterase-9 / *Est-9*^{1}, *Est-9*^{2} (**7**, SANO & BARBIER 1985, RANJHAN *et al.* 1988, PHAM *et al.* 1990)
eui elongated uppermost internode (**5**, RUTGER & CARNAHAN 1981, MAEKAWA *et al.* 1989)
fc-1 fine culm-1 (**3**, IWATA & OMURA 1977)
fc-2 (t) fine culm-2 (**6**, SATOH *et al.* 1983, 1986)
Fdp-1 Fructose-1, 6-diphosphatase / *Fdp-1*^{0}, *Fdp-1*^{1}, *Fdp-1*^{2} (**11**, BRAR *et al.* 1990*, REYES *et al.* 1989)
fes-1 female sterile-1 / duplicate (YOKOO 1984)
fes-2 female sterile-1 (YOKOO 1984)
Fes-3 (*Fes-2*) Female sterile-3 (RAZZAQUE 1974)
fgl (*fl*) faded green leaf (**10**, IWATA & OMURA 1975)
flo-1 floury endosperm-1 (**5**, SATOH & OMURA 1986, SATOH & IWATA 1990*)

flo-2	floury endosperm-2 (SATOH & OMURA 1986)
flo-3 (t)	floury endosperm-3 (**4**, MAEKAWA 1985)
fs-1 (*fs*)	fine stripe-1 (**6**, NAGAO & TAKAHASHI 1963, KINOSHITA *et al.* 1975)
fs-2	fine stripe-2 (**1**, TAKAHASHI *et al.* 1968)
Fsc (*Fc*)	Fuscoid cells attached to vascular bundles (SETHI and ROY 1984)
g-1 (*g*)	long sterile lemmas-1 (**7**, NAGAO & TAKAHASHI 1963)
G-2 (*Gm, Gl*)	Long sterile lemmas-2 (JODON 1957)
G6pd-1 (*t*)	Glucose-6-phosphate dehydrogenase (BRAR *et al.* 1990*)
ga-1	gametophyte gene-1 (**6**, IWATA *et al.* 1964)
ga-2	gametophyte gene-2 (**3**, NAKAGAHRA 1972, NAKAGAHRA *et al.* 1972)
ga-3	gametophyte gene-3 (**3**, NAKAGAHRA *et al.* 1972)
ga-4 (*ga-A*)	gametophyte gene-4 (**6**, MORI *et al.* 1973b, NAKAGAHRA *et al.* 1974)
ga-5 (*ga-B*)	gametophyte gene-5 (**6**, MORI *et al.* 1973b)
ga-6	gametophyte gene-6 (**4**, MAEKAWA *et al.* 1981)
ga-7	gametophyte gene-7 (**1**, MAEKAWA & KITA 1985)
ga-8	gametophyte gene-8 (**1**, NAKAGAHRA 1981)
ga-9	gametophyte gene-9 (**1**, MAEKAWA & KITA 1985)
ga-10 (t)	gametophyte gene-10 (**4**, KINOSHITA & TAKAMURE 1984)
Gdh-1	Glutamate dehydrogenase-1 / *Gdh-1*^{1}, *Gdh-1*^{2} (**3**, ISHIKAWA *et al.* 1989a)
ge	giant embryo (**7**, SATOH & OMURA 1981, SATOH & IWATA 1990*)
gf	gold furrows of hull (**6**, JODON & ATKINS 1966)
gh-1	gold hull and internode-1 (**5** or **3**?, NAGAO & TAKAHASHI 1963, IWATA *et al.* 1985)
gh-2	gold hull and internode-2 (**2**, IWATA & OMURA 1971b)
gh-3	gold hull and internode-3 (**2**, IWATA & OMURA 1977)
gl-1	glabrous leaf and hull / duplicate (**5**, NAGAO & TAKAHASHI 1963)
gl-2	glabrous leaf and hull (OKA 1953b)
Glh-1	Green leafhopper resistance-1 (ATHWAL *et al.* 1971)
Glh-2	Green leafhopper resistance-2 (ATHWAL *et al.* 1971, SIWI & KHUSH 1977)
Glh-3	Green leafhopper resistance-3 (**10**, ATHWAL *et al.* 1971, SIWI & KHUSH 1977)
glh-4	green leafhopper resistance-4 (SIWI & KHUSH 1977)
Glh-5	Green leafhopper resistance-5 (SIWI & KHUSH 1977)
Glh-6	Green leafhopper resistance-6 (**5**, REZAUL KARIM & PATHAK 1982, TOMAR & S. D. TOMAR 1987)
Glh-7	Green leafhopper resistance-7 (REZAUL KARIM & PATHAK 1982)
Gm-1 (*gm, pd*)	Gall midge resistance-1 / (SHASTRY *et al.* 1972, SASTRY *et al.* 1975, CHAUDHARY *et al.* 1986)
Gm-2	Gall midge resistance-2 (CHAUDHARY *et al.* 1986)
Got-1	Aspartate aminotransferase-1 / *Got-1*^{1}, *Got-1*^{2}, *Got-1*^{3} (**1**, WU *et al.* 1988, PHAM *et al.* 1990)
Got-2	Aspartate aminotransferase-2 / *Got-2*^{1}, *Got-2*^{2} (**6**, SECOND 1982, PHAM *et al.* 1990)
Got-3	Aspartate aminotransferase-3 / *Got-3*^{1}, *Got-3*^{2} (**2**, SECOND 1982, BRAR *et al.* 1990*, PHAM *et al.* 1990)
Grh-1	Green rice leafhopper resistance / duplicate or complementary (KOBAYASHI *et al.* 1980, KANEDA 1988)
Grh-2	Green rice leafhopper resistance (KOBAYASHI *et al.* 1980, KANEDA 1988)
Gsv (*Gs*)	Grassy stunt resistance (KHUSH & LING 1974)
Gt (t)	High gelatinization temperature (HSIEH & WANG 1989*)
H (t)	Hardness of cooked rice (HSIEH & WANG 1989*)

Hbv — *Hoja blanca* resistance (TORIYAMA 1967)
hca-1 — hybrid chorosis-a / complementary (SATO *et al.* 1984)
hca-2 — hybrid chlorosis-a (SATO *et al.* 1984)
He — *Helminthosporium oryzae* resistance (NAGAI & HARA 1930)
Hg — Hairy glume (**3**, NAGAO & TAKAHASHI 1963)
Hl-a — Hairy leaf / complementary (**6**, NAGAO & TAKAHASHI 1963)
Hl-b — Hairy leaf (NAGAO & TAKAHASHI 1963)
hpr-1 — hydroxyproline resistance-1 (HASEGAWA & INOUE 1983, HASEGAWA *et al.* 1985)
hpr-2 (t) — hydroxyproline resistance-2 (HASEGAWA & INOUE 1983, HASEGAWA *et al.* 1985)
hpr-3 (t) — hydroxyproline resistance-3 (HASEGAWA & INOUE 1983, HASEGAWA *et al.* 1985)
Hwa-1 (*L-1-a*) — Hybrid weakness (lethal)-a / complementary (OKA 1957a)
Hwa-2 (*L-1-b*) — Hybrid weakness (lethal)-a (OKA 1957a)
hwb-1 (*w'-a*) — F_2 weakness-b (CHU & OKA 1972)
hwb-2 (*w'-b*) — F_2 weakness-b (CHU & OKA 1972)
Hwc-1 (*L-2-a*) — Hybrid weakness (lethal)-c / complementary (AMEMIYA & AKEMINE 1963)
Hwc-2 (*L-2-b*) — Hybrid weakness (lethal)-c (AMEMIYA & AKEMINE 1963)
I-Bf — Inhibitor for brown furrows (**9**, NAGAO & TAKAHASHI 1963)
I-Bph-1 — Inhibitor for *Bph-1* (MARTINEZ & KHUSH 1974)
Icd-1 (*Idh-A*) — Isocitrate dehydrogenase-1 / *Icd-1*^{1}, *Icd-1*^{2}, *Icd-1*^{3} (**1**, WU *et al.* 1988, PHAM *et al.* 1990)
I-Pl-1 — Inhibitor for purple leaf-1 / duplicate or triplicate (**5**, NAGAO *et al.* 1962)
I-Pl-2 — Inhibitor for purple leaf-2 (**6**, NAGAO *et al.* 1962, KINOSHITA & TAKAMURE 1990)
I-Pl-3 — Inhibitor for purple leaf-3 (NAGAO *et al.* 1962)
I-Pl-4 — Inhibitor for purple pericarp / complementary (**6**, KINOSHITA & TAKAMURE 1990)
I-Pl-5 — Inhibitor for purple pericarp (KINOSHITA & TAKAHASHI 1990)
I-Pl-6 — Inhibitor for purple leaf (*Pl*^{i}) (KINOSHITA & MAEKAWA 1986)
I-Ps-a (*I-Ps-1*) — Inhibitor for purple stigma / complementary (HSIEH 1961)
I-Ps-b (*I-Ps-2*) — Inhibitor for purple stigma (**1**, HSIEH 1961)
i-Se-1 — recessive inhibitor for photosensitivity (*Se-1*) (CHANG *et al.* 1969)
la — lazy growth habit (**11**, NAGAO & TAKAHASHI 1963)
lam (t) — low amylose endosperm (**9**, KIKUCHI & KINOSHITA 1987)
lax (*lx*) — lax panicle (**1**, IWATA & OMURA 1971a)
lf-1 — late flowering-1 (TSAI 1986)
lf-2 — late flowering-2 (TSAI 1986)
lg — liguleless / *lg*^{a} (**4**, NAGAO & TAKAHASHI 1963, MAEKAWA 1988b)
lgp — light green panicle and leaf (RUTGER *et al.* 1986)
lgt — long twisted grain (**1**, HSIEH 1960)
lhd — leafy head (HU 1961)
lhs-1 (=*lhs-2, op*) — leafy hull sterile (**3**, KINOSHITA *et al.* 1977, KHUSH & LIBROJO 1985)
Lk-f — 'Fusayoshi' long grain (**3**, TAKEDA & SAITO 1980)
lk-i — 'IRAT 13' long grain (**4**, TAKAMURE & KINOSHITA 1989, KINOSHITA & TAKAMURE 1990)
lp-1 — long palea / duplicate (**7**, THAKUR & ROY 1975)
lp-2 — long palea (THAKUR & ROY 1975)

lt (t)	gametic lethal / lt^m (**11**, TOMITA *et al.* 1989*, TANISAKA *et al.* 1990)
m-Ef-1	modifier for *Ef-1* / m^a-*Ef-1*, m^b-*Ef-1* (**7**, TSAI & OKA 1970, TSAI 1984)
Mal-1	Malate dehydrogenase (NADP)-1(**7**, BRAR *et al.* 1990*)
Mdh-1	Malate dehydrogenase (NAD)-1 (SECOND 1982, PHAM *et al.* 1990)
Mi	Minute grain (**3**, TAKEDA & SAITO 1977, TAKAMURE & KINOSHITA 1983)
mls-1	malformed lemma / duplicate (TAKAHASHI *et al.* 1968)
mls-2	malformed lemma (TAKAHASHI *et al.* 1968)
mp-1	multiple pistil-1 (**1**, LIBROJO & KHUSH 1986, PAVITHRAN *et al.* 1989*)
mp-2	multiple pistil-2 (**6**, LIBROJO & KHUSH 1986)
M-Pi-z (*Rb-6*)	Modifier for *Pi-z* (**11**, GOTO 1976)
M-Pox-1 (*Mpx-1*)	Modifier for *Pox-1* / *M-Pox-1*^{0}, *M-Pox-1*^{1} (**5**, PAI 1985, PAI & JAN 1988)
ms-1 (*sf*)	male sterile-1 (**6**, HARA 1946)
ms-2 (*ms-d*)	male sterile-2 (SHIBUYA 1973)
ms-3 (*ms-1*)	male sterile-3 (SHIBUYA 1973)
ms-4 (*ms-2*)	male sterile-4 (SHIBUYA 1973)
ms-5 (*ms-3*)	male sterile-5 (SHIBUYA 1973)
ms-6 (*ms-4*)	male sterile-6 (SHIBUYA 1973)
ms-7	male sterile-7 (**3**, KO & YAMAGATA 1987, 1989)
ms-8	male sterile-8 (**7**, KO & YAMAGATA 1987, 1989)
ms-9	male sterile-9 (**6**, KO & YAMAGATA 1987, SATO 1989)
ms-10	male sterile-10 (**9**, KO & YAMAGATA 1985, 1987)
ms-11	male sterile-11 (KO & YAMAGATA 1987)
ms-12	male sterile-12 (KO & YAMAGATA 1987)
ms-13	male sterile-13 (KO & YAMAGATA 1987)
ms-14	male sterile-14 (**5**, KO & YAMAGATA 1985, 1987)
ms-15	male sterile-15 (KO & YAMAGATA 1987)
ms-16	male sterile-16 (KO & YAMAGATA 1987)
ms-17	male sterile-17 (**2**, KO & YAMAGATA 1987, 1989, SUH *et al.* 1989*)
ms-18	male sterile-18 (**1**, SUH *et al.* 1989, SUH 1990*)
nal-1	narrow leaf-1 / duplicate or triplicate (**4**, MORI *et al.* 1973a)
nal-2	narrow leaf-1 (**11**, MORI *et al.* 1973a)
nal-3 (*nal-2*)	narrow leaf-3 (**12**, IWATA & OMURA 1975)
nal-4 (*nal*)	narrow leaf-4 (**4**, YEN *et al.* 1968)
nal-5 (*nal-1*)	narrow leaf-5 (**4**, IWATA & OMURA 1977)
Nal-6 (t)	Narrow leaf-6 (**3**, IWATA *et al.* 1985)
Nd	Early nodal differentiation (TRIPATHI & RAO 1985)
nl-1	neck leaf-1 (**5**, NAGAO & TAKAHASHI 1963, SATO *et al.* 1982)
nl-2	neck leaf-2 (**5**, IWATA & OMURA 1977)
np	nude panicle (PAVITHRAN 1983)
Nr-1	Nodal rooting / complementary (TRIPATHI & RAO 1985)
Nr-2	Nodal rooting (TRIPATHI & RAO 1985)
oms	open hull male sterile (TAKEDA 1987)
ops	open hull sterile (**5**, IWATA & OMURA 1971a)
P	Colored apiculus / P^K, P^C (**4**, NAGAO & TAKAHASHI 1963, MORI & TAKAHASHI 1981)
Pau	Purple auricle (MISRO 1981, SINGH *et al.* 1989)
Pc	Purple coleoptile (MISRO 1981)
pcs	pentachlorobenzyl alcohol susceptibility (SEKIGUCHI *et al.* 1972)

Pd	Pendant panicle (MISRO 1981)
Pgd-1	Phosphogluconate dehydrogenase-1 / *Pgd-1*^{1}, *Pgd-1*^{2}, *Pgd-1*^{3} (**11**, WU *et al.* 1988, ISHIKAWA *et al.* 1988, 1989a, PHAM *et al.* 1990)
Pgd-2	Phosphogluconate dehydrogenase-2 / *Pgd-2*^{1}, *Pgd-2*^{2} (**6**, SECOND 1982, ISHIKAWA & MORISHIMA 1989)
Pgi-1	Phosphoglucose isomerase-1 / *Pgi-1*^{0}, *Pgi-1*^{1}, *Pgi-1*^{2}, *Pgi-1*^{3} (**3**, RANJHAN *et al.* 1988, ISHIKAWA *et al.* 1989a)
Pgi-2	Phosphoglucose isomerase-2 / *Pgi-2*^{1}, *Pgi-2*^{2}, *Pgi-2*^{3}, *Pgi-2*^{4} (**6**, SANO & BARBIER 1985, PHAM *et al.* 1990)
Pgi-3	Phosphoglucose isomerase-3 / *Pgi-3*^{0}, *Pgi-3*^{1} (GLASZMANN 1986, PHAM *et al.* 1990)
pgl	pale green leaf (**10**, IWATA & OMURA 1975)
Ph=Bh-c (*Po*)	Phenol staining (**4**, NAGAO & TAKAHASHI 1963)
Pi-a	*Pyricularia oryzae* resistance-a (**11**, SHINODA *et al.* 1971, KIYOSAWA 1972)
Pi-b (*Pi-s*)	*Pyricularia oryzae* resistance-b (**2**, SHINODA *et al.* 1971, KIYOSAWA 1972)
Pi-f	*Pyricularia oryzae* resistance-f (**11**, YUNOKI *et al.* 1970, SHINODA *et al.* 1971)
Pi-i	*Pyricularia oryzae* resistance-i (**6**, SHINODA *et al.* 1971, KIYOSAWA 1972)
Pi-k	*Pyricularia oryzae* resistance-k / *Pi-k*^{s}, *Pi-k*^{p}, *Pi-k*^{m} (*Pi-m*), *Pi-k*^{h} (**11**, SHINODA *et al.* 1971, KIYOSAWA 1972)
Pi-sh	*Pyricularia oryzae* resistance-sh (IMBE & MATSUMOTO 1985)
Pi-t	*Pyricularia oryzae* resistance-t (KIYOSAWA 1972)
Pi-ta (=*sl*)	*Pyricularia oryzae* resistance-ta / *Pi-ta*^{2}, *Pi-ta*^{n} (**9**, SHINODA *et al.* 1971, KIYOSAWA 1972)
Pi-z	*Pyricularia oryzae* resistance-z / *Pi-z*^{t} (**6**, KIYOSAWA 1967, 1972, SHINODA *et al.* 1971)
Pi-is-1 (*Rb-4*)	*Pyricularia oryzae* resistance-is / cumulative (**11**, GOTO 1970)
Pi-is-2 (*Rb-5*)	*Pyricularia oryzae* resistance-is (GOTO 1970)
Pi-se-1 (*Rb-1*)	*Pyricularia oryzae* resistance-se / additive (**11**, GOTO & BALUCH 1983, 1984)
Pi-se-2 (*Rb-2*)	*Pyricularia oryzae* resistance-se (GOTO & BALUCH 1983, 1984)
Pi-se-3 (*Rb-3*)	*Pyricularia oryzae* resistance-se (GOTO & BALUCH 1983)
Pi(t)	*Pyricularia oryzae* resistance (**4**, HSIEH 1976)
Pin-1	Purple internode-1 (**4**, MORI *et al.* 1981)
Pj	Purple junctura (MISRO 1981, SINGH *et al.* 1989)
Pjb	Purple junctura back (MISRO 1981)
Pl	Purple leaf / *Pl*^{w}, *Pl*^{i} (*Pl'*) (**4**, TAKAHASHI 1982, KINOSHITA & MAEKAWA 1986)
Pla	Purple leaf apex (MISRO 1981)
Plg	Purple ligule (MISRO 1981)
Plm (*Pla*)	Purple leaf margin (MISRO 1981)
Pm (*Sp*)	Purple septum (MISRO 1981)
Pmr (*Plm*)	Purple midrib (MISRO 1981)
Pn	Purple node (**1**, NAGAO & TAKAHASHI 1963)
Pnr	Purple nodal ring (DHULAPPANAVAR 1979)
Pox-1 (*Px, Pe*)	Peroxidase-1 / *Pox-1*^{0}, *Pox-1*^{1} (*Pox-1*^{0C}) (**5**, PAI *et al.* 1973, PAI & JAN 1988)
Pox-2	Peroxidase-2 / *Pox-2*^{0}, *Pox-2*^{1} (*Pox-2*^{4C}) (**12**, ISHIKAWA *et al.* 1989a, b, WU *et al.* 1988, PHAM *et al.* 1990)
Pox-3	Peroxidase-3 / *Pox-3*^{1} (*Pox-3*^{3C}), *Pox-3*^{2} (*Pox-3*^{5C}) (**3** or **4**?, PAI & FU 1977, PHAM *et al.* 1990)
Pox-4	Peroxidase-4 / *Pox-4*^{1}, *Pox-4*^{2} (**3** or **4**?, SECOND 1982, PHAM *et al.* 1990)

Pox-5	Peroxidase-5 / *Pox-5*^{1}, *Pox-5*^{2} (**6**, WU *et al.* 1988)
Pr	Purple hull (**4**, NAGAO & TAKAHASHI 1963)
Prp-b (*Pb*)	Purple pericarp (**4**, HSIEH & CHANG 1964)
prs	propanil susceptibility (MATSUNAKA 1972)
Ps-1	Purple stigma-1 (**4**, TAKAHASHI 1958, OKA 1990)
Ps-2	Purple stigma-2 (**4**, HSIEH 1961, OKA 1990)
Psh	Purple leaf sheath (MISRO 1981, SINGH *et al.* 1989)
Pu	Purple pulvinus (MISRO 1981)
Px	Purple leaf axil (MISRO 1981)
Rc	Brown pericarp and seed coat / *Rc*^{s} (**7**, NAGAO and TAKAHASHI 1963, TAKAHASHI *et al.* 1972)
rcn-1	reduced culm number-1 (**6**, TAKAMURE & KINOSHITA 1985)
rcn-2	reduced culm number-2 (**4**, TAKAMURE & KINOSHITA 1987, TAKAMURE *et al.* 1989)
rcn-3	reduced culm number-3 (TAKAMURE *et al.* 1989)
Rcp	Receptor gene for peroxidase / *Rcp*^{2A}, *Rcp*^{4A} (ENDO 1981)
Rd	Red pericarp and seed coat (**1**, NAGAO & TAKAHASHI 1963)
Reg-1^{2A}	Regulator gene for peroxidase-1 (ENDO 1981)
Reg-2^{4A}	Regulator gene for peroxidase-2 (ENDO 1981)
Rf-1	Pollen fertility restoration-1 / *Rf-1*^{a}, *Rf-1*^{b}, *Rf-1*^{c}, *Rf-1*^{d}, *Rf-1*^{e} (**10**, SHINJO 1975, 1990)
Rf-2 (*Rf-x*)	Pollen fertility restoration-2 (SHINJO *et al.* 1974)
Rf-a, b, c	Pollen fertility restoration / complementary (MAEKAWA 1982)
Rf-a, b, c, d	Pollen fertility restoration / complementary (MAEKAWA 1982)
Rf-ak (*Rf-i*)	Pollen fertility restoration-ak (YABUNO 1977)
rfs	rolled fine striped leaf (**7**, IWATA *et al.* 1981)
ri	verticillate rachis (**5**, NAGAO & TAKAHASHI 1963)
rk-1	round kernel-1 (**4**, IWATA and OMURA 1975)
rk-2	round kernel-2 (**10**, YOHIMURA *et al.* 1982)
rl-1	rolled leaf-1 (**1**, NAGAO *et al.* 1964)
rl-2	rolled leaf-2 (**4**, MORI *et al.* 1973a)
rl-3 (*rl-1*)	rolled leaf-3 (**12**, IWATA & OMURA 1975, YOSHIMURA *et al.* 1982)
rl-4 (*rl-2*)	rolled leaf-4 (**1**, IWATA & OMURA 1977)
rl-5 (*rl-3*)	rolled leaf-5 (**3**, IWATA *et al.* 1979b)
rl-6 (t)	rolled leaf-6 (**7**, THAKUR 1984)
$R_{LB}{}^{4C}$	Regulator gene for peroxidase (PAI *et al.* 1973)
$R_{LS}{}^{4C}$	Regulator gene for peroxidase (PAI *et al.* 1973)
rt	root growth inhibition (FUTSUHARA & KITANO 1985)
S-1	Hybrid sterility-1 / *S-1*^{a} / sporo-gametophytic interaction (**6**, SANO *et al.* 1979, SANO 1990a)
S-2	Hybrid sterility-2 / *S-2*^{a} / sporo-gametophytic interaction (SANO *et al.* 1979)
S-3	Hybrid sterility-3 / *S-3*^{a} / sporo-gametophytic interaction (**11**, SANO 1983)
S-4	Hybrid sterility-4 / *S-4*^{a} / sporo-gametophytic interaction (SANO 1983, 1985)
S-5	Hybrid sterility-5 / *S-5*^{n}, *S-5*^{j}, *S-5*^{i}, *S-5*^{p} / sporo-gametophytic interaction (**6**, IKEHASHI & ARAKI 1986)
S-6	Hybrid sterility-6 / *S-6*^{a} / sporo-gametophytic interaction (**6**, SANO 1989)
S-A-1 (*A-1*)	Hybrid sterility-A / sporophytic F_2 sterility / duplicate (**6**, OKA & DOIDA 1962)
S-A-2 (*A-2*)	Hybrid sterility-A (OKA & DOIDA 1962)

s-a-1(s-1)	hybrid sterility-a / gametophytic F_1 sterility / duplicate (**6**, OKA 1974)
s-a-2(s-2)	hybrid sterility-a (OKA 1974)
S-B-1(B-1)	Hybrid sterility-B / sporophytic F_2 sterility / duplicate (OKA & DOIDA 1962)
S-B-2(B-2)	Hybrid sterility-B (**6**, OKA & DOIDA 1962)
Sb	Stem borer resistance (DUTT *et al.* 1980)
Sc-1	*Sclerotium oryzae* resistance / duplicate (HASHIOKA 1951)
Sc-2	*Sclerotium oryzae* resistance (HASHIOKA 1951)
s-c-1	hybrid sterility-c / gametophytic F_1 sterility / duplicate (**6**, OKA 1957b)
s-c-2	hybrid sterility-c (**4**, OKA 1957b)
sd-1(d-47)	dee-geo-woo-gen semidwarf (**1**, AQUINO & JENNINGS 1966, SUH & HEU 1978)
sd-2	semidwarf-2 (CI11033) (FOSTER & RUTGER 1978a, b)
sd-3	semidwarf-3 (CI9858) (FOSTER & RUTGER 1978b)
sd-4	semidwarf-4 (CI11034) (MACKILL & RUTGER 1979)
sd-5	semidwarf-5 (Short Labelle) (MCKENZIE & RUTGER 1986)
sd-6 (t)	semidwarf-6 (R-34) (HU 1987)
sd-7 (t)	semidwarf-7 (D56-31) (TSAI 1989)
s-d-1	hybrid sterility-d / gametophytic F_1 sterility / duplicate (**6**, OKA 1974)
s-d-2	hybrid sterility-d (OKA 1974)
Sdh-1	Shikimate dehydrogenase-1 / *Sdh-1*^{1}, *Sdh-1*^{2}, *Sdh-1*^{3}, *Sdh-1*^{4} (**12**, RANJHAN *et al.* 1988, ISHIKAWA *et al.* 1989a, PHAM *et al.* 1990)
Sdr-a(Sd)	Seed dormancy / complementary (TAKAHASHI 1962)
Sdr-b	Seed dormancy (TAKAHASHI 1962)
Se-1(Lm, Lf, Rs, Fl)	Photosensitivity-1 / *Se-1*^{e}, *Se-1*^{n}, *Se-1*^{t}, *Se-1*^{s}, *Se-1*^{u} (**6**, YOKOO & KIKUCHI 1977, 1978, 1982)
se-2	photosensitivity-2 (**7**, YU & YAO 1968)
Se-3 (t)	Photosensitivity-3 (POONYARIT *et al.* 1987, 1989)
s-e-1	hybrid sterility-e / gametophytic F_1 sterility / duplicate (**3**, OKA 1974)
s-e-2	hybrid sterility-e (**4**, OKA 1974)
Sg	Permeability of testa to water (TAKAHASHI 1962)
sh-1	shattering-1 (**11**, NAGAO & TAKAHASHI 1963)
sh-2	shattering-2 (**1**, OBA *et al.* 1990)
Sh-3	Shattering-3 (**4**, SANO & EIGUCHI 1990)
Shp-1(Ex)	Sheathed panicle-1 (**1**, MAEKAWA 1986)
shp-2	sheathed panicle-2 (MAEKAWA 1986)
Sph-3(Ga)	Sheathed panicle-3 / complementary (**5**, SHRESTHA 1984, HEU & SHRESTHA 1986)
Shp-4(Gb)	Sheathed panicle-3 (**3**, SHRESTHA 1984, HEU & SHRESTHA 1986)
shr-1	shrunken eudosperm-1 / *shr-1*^{s}, *shr-1*^{a} (**1**, YANO *et al.* 1984, MATSUO *et al.* 1986a)
shr-2	shrunken endosperm-2 (**8**, MATSUO *et al.* 1986b)
Sk	Scented kernel (TRIPATHI & RAO 1979, BERNER & HOFF 1986, TSUZUKI & SHIMOKAWA 1990)
Sm	Stem maggot resistance (ATHWAL & PATHAK 1972)
sp	short panicle (**11**, IWATA & OMURA 1971b)
spl-1(sl)	spotted leaf-1 (**12**, IWATA & OMURA 1975, IWATA *et al.* 1978a)
spl-2	spotted leaf-2 (**2**, IWATA *et al.* 1978a)
spl-3	spotted leaf-3 (**3**, IWATA *et al.* 1978a)
spl-4	spotted leaf-4 (**6**, IWATA *et al.* 1978a)
spl-5	spotted leaf-5 (**7**, IWATA and OMURA 1977, IWATA *et al.* 1978a)
spl-6	spotted leaf-6 (**1**, IWATA *et al.* 1978a)

spl-7	spotted leaf-7 (**5**, IWATA *et al.* 1978a)
spl-8 (*bl-8*)	spotted leaf-8 (**5**, IWATA *et al.* 1978a)
spl-9	spotted leaf-9 (IWATA *et al.* 1978a)
spr-1	spreading panicle-1 (**4**, KINOSHITA & TAKAMURE 1986)
Spr-2	Spreading panicle-2 (MITRA & GANGULI 1932)
Spr-3 (t)	Spreading panicle-3 (**4**, SANO & EIGUCHI 1990)
st-1 (*ws-1*)	stripe-1 (**6**, NAGAMATSU & OMURA 1962)
st-2 (*gw*)	stripe-2 (**5**, NAGAO & TAKAHASHI 1963)
st-3 (*stl*)	stripe-3 (**3**, IWATA *et al.* 1979b)
st-4 (*ws-2*)	stripe-4 (**4**, MAEKAWA 1982)
st-5	stripe-5 (**4**, MAEKAWA 1988a)
Stv-a (*St-1*)	Stripe disease resistance / complementary (**6**, WASHIO *et al.* 1968a, b, c)
Stv-b (*St-2*)	Stripe disease resistance / *stv-b*^{i} (**8**, WASHIO *et al.* 1968a, b, c)
Su-2-1	Suppressor for long sterile lemmas (NAGAO & TAKAHASHI 1963)
Sud-1 (*t*)	Succinate dehydrogenase-1 (BRAR et al. 1990*)
Sud-2 (*t*)	Succinate dehydrogenase-2 (BRAR et al. 1990*)
Sud-3 (*t*)	Succinate dehydrogenase-3 (BRAR et al. 1990*)
sug (*su*)	sugary endosperm (**8**, SATOH & OMURA 1981, YANO *et al.* 1984)
Th	Hard threshability (KUMAR & SHARMA 1982)
Tpi-1 (*t*)	Triosephosphate isomerase-1 (BRAR *et al.* 1990*)
tri	triangular hull (**2**, IWATA & OMURA 1971b)
ts-a	twisted stem / complementary (**1**, HSIEH 1960)
ts-b	twisted stem (HSIEH 1960)
Tuv-a	Tungro resistance / complementary (TORIYAMA 1967)
Tuv-b	Tungro resistance (TORIYAMA 1967)
Un-a	Uneven grain / complementary (**6**, THAKUR & ROY 1975)
Un-b	Uneven grain (**7**, THAKUR & ROY 1975)
Ur-1 (*Ur*)	Undulate rachis-1 (**6**, NAGAO & TAKAHASHI 1963)
ur-2	undulate rechis-2 (**8**, IWATA *et al.* 1983)
v-1	virescent-1 (**6**, JODON 1940, 1955)
v-1 (t)	virescent-1 (**3**, OMURA *et al.* 1978)
v-2	virescent-2 (**3**, OMURA *et al.* 1978)
v-3	virescent-3 (**6**, OMURA *et al.* 1978)
v-4	virescent-4 (**11**, OMURA *et al.* 1978)
v-5	virescent-5 (**3**, OMURA *et al.* 1978)
v-6	virescent-6 (**1**, IWATA *et al.* 1979a)
v-7	virescent-7 (**3**, IWATA *et al.* 1979b)
v-8	virescent-8 (**8**, IWATA *et al.* 1983)
v-9 (t)	virescent-9 (**11**, SATOH *et al.* 1984)
v-10 (t)	virescent-10 (**5**, SATOH *et al.* 1984)
v-11 (t)	virescent-11 (**7**, SATOH *et al.* 1984)
Wh	White hull (**4**, NAGAO & TAKAHASHI 1963)
Wph-1 (*Wbph*)	White-backed planthopper resistance-1 (SIDHU *et al.* 1979, ANGELES *et al.* 1981)
Wph-2	White-backed planthopper resistance-2 (ANGELES *et al.* 1981)
Wph-3	White-backed planthopper resistance-3 (HERNANDEZ & KHUSH 1981)
wph-4	white-backed planthopper resistance-4 (HERNANDEZ & KHUSH 1981)
Wph-5	White-backed planthopper resistance-5 (WU & KHUSH 1984, SINGH *et al.* 1990)

wx, Wx	glutinous endosperm/wx^{op}, Waxy protein/Wx^a, Wx^b (**6**, NAGAO & TAKAHASHI 1963, SANO 1984, SATOH & OMURA 1986, HEU & KIM 1989*)
Xa-1(Xe)	*Xanthomonas campestris* pv. *oryzae* resistance-1 / $Xa\text{-}1^h$ (**4**, SAKAGUCHI 1967)
Xa-2	*Xanthomonas campestris* pv. *oryzae* resistance-2 (**4**, SAKAGUCHI 1967)
Xa-3=Xa-4^b, *6, 9, Xa-w*	*Xanthomonas campestris* pv. *oryzae* resistance-3 (OGAWA *et al.* 1978, 1986a, b, 1990a, b, SINGH *et al.* 1983)
Xa-4(Xa-4^a)	*Xanthomonas campestris* pv. *oryzae* resistance-4 (**11**, PETPISIT *et al.* 1977, SIDHU *et al.* 1978a, SINGH *et al.* 1983)
Xa-5	*Xanthomonas campestris* pv. *oryzae* resistance-5 (**5**, SIDHU *et al.* 1978a, SINGH *et al.* 1983, YOSHIMURA *et al.* 1983)
Xa-7	*Xanthomonas campestris* pv. *oryzae* resistance-7 (SIDHU *et al.* 1978a, SINGH *et al.* 1983)
Xa-8	*Xanthomonas campestris* pv. *oryzae* resistance-8 (SIDHU *et al.* 1978a, SINGH *et al.* 1983)
Xa-10	*Xanthomonas campestris* pv. *oryzae* resistance-10 (**11**, YOSHIMURA *et al.* 1984)
Xa-11(Xa-pt)	*Xanthomonas campestris* pv. *oryzae* resistance-11 (OGAWA & YAMAMOTO 1986)
Xa-12 (Xa-kg)	*Xanthomonas campestris* pv. *oryzae* resistance-12 / $Xa\text{-}12^h$ ($Xa\text{-}kg^h$) (**4**, OGAWA *et al.* 1978, YAMADA & HORINO 1981)
Xa-13	*Xanthomonas campestris* pv. *oryzae* resistance-13 (**5**, OGAWA *et al.* 1987b, SAHU & KHUSH 1989)
Xa-14	*Xanthomonas campestris* pv. *oryzae* resistance-14 (**4**, TAURA *et al.* 1987)
Xa-16	*Xanthomonas campestris* pv. *oryzae* resistance-16 (NODA & OHUCHI 1989)
Xa-17	*Xanthomonas campestris* pv. *oryzae* resistance-17 (OGAWA *et al.* 1989)
Xa-18	*Xanthomonas campestris* pv. *oryzae* resistance-18 (YAMAMOTO & OGAWA 1989)
Xa-19	*Xanthomonas campestris* pv. *oryzae* resistance-19 (TAURA *et al.* 1989)
Xa-20	*Xanthomonas campestris* pv. *oryzae* resistance-20 (TAURA *et al.* 1989)
Xdh-1(t)	Xanthine dehydrogenase-1 (REYES *et al.* 1989)
Ydv	Yellow dwarf disease resistance (MORINAKA *et al.* 1970)
ygl	yellow green leaf (**10**, LIBROJO & KHUSH 1986)
ylb	yellow banded leaf blade (**5**, HSIEH 1961)
ylm	yellow leaf margin (**4**, IWATA & OMURA 1977)
yp	yellow panicle (RUTGER *et al.* 1986)
ysl	yellow leaf spot (TAKAHASHI *et al.* 1968)
z-1	zebra-1 (**11**, IWATA & OMURA 1975)
z-2	zebra-2 (**11**, IWATA & OMURA 1977)
z-3	zebra-3 (**3**, IWATA *et al.* 1979b)
z-4	zebra-4 (**8**, IWATA *et al.* 1983)
z-5	zebra-5 (**4**, KINOSHITA & TAKAMURE 1984)
z-6	zebra-6 (**7**, MAEKAWA 1987)
Zlh-1	Zigzag leafhopper resistance-1 (ANGELES *et al.* 1986)
Zlh-2	Zigzag leafhopper resistance-2 (ANGELES *et al.* 1986)
Zlh-3	Zigzag leafhopper resistance-3 (ANGELES *et al.* 1986)
zn	zebra necrosis (**6**, KINOSHITA & TAKAMURE 1984)

* additional literatures.

Table 4. Classification of marker genes into different character groups

Gene symbol	Name of marker	Linkage group
Anthocyanin coloration		
C	Chromogen for anthocyanin/C^{Bs}, C^{B}, C^{Bp}, C^{Bt}, C^{Br}, C^{Bd}, C^{Bk}, C^{Bc}, C^{Bm}	6
A	Anthocyanin activator/A^{S}, A^{E}, A^{d}, A^{m}	1
P	Colored apiculus/P^{K}, P^{C}	4
Pau	Purple auricle	
Pc	Purple coleoptile	
Pin-1	Purple internode-1	4
Pj	Purple junctura	
Pjb	Purple junctura back	
Pl	Purple leaf/Pl^{w}, Pl^{i}	4
Pla	Purple leaf apex	
Plg	Purple ligule	
Plm (*Pla*)	Purple leaf margin	
Pm (*Sp*)	Purple septum	
Pmr (*Plm*)	Purple midrib	
Pn	Purple node	1
Pnr	Purple nodal ring	
Pr	Purple hull	4
Prp-a (*Pp*)	Purple pericarp/complementary	1
Prp-b (*Pb*)	Ditto	4
Ps-1	Purple stigma-1	4
Ps-2	Ditto-2	4
Psh	Purple leaf sheath	
Pu	Purple pulvinus	
Px	Purple leaf axil	
Inhibitor for anthocyanin coloration		
I-Pl-1	Inhibitor for purple leaf-1	5
I-Pl-2	Ditto-2	6
I-Pl-3	Ditto-3	
I-Pl-4	Inhibitor for purple pericarp	6
I-Pl-5	Ditto	
I-Pl-6	Inhibitor for purple leaf (Pl^{i})	
I-Ps-a (*I-Ps-1*)	Inhibitor for purple stigma/complementary	
I-Ps-b (*I-Ps-2*)	Ditto	1
Coloration other than anthocyanin		
Bf	Brown furrows of hull	
I-Bf	Inhibitor for brown furrows	9
Bh-a (*Bh-1*)	Black hull/complementary	
Bh-b (*Bh-2*)	Ditto	
Bh-c (=*Ph*)	Ditto	4
gf	gold furrows of hull	6
gh-1	gold hull and internode-1	5
gh-2	ditto-2	2
gh-3	ditto-3	2

Rc	Brown pericarp and seed coat/Rc^S	7
Rd	Red pericarp and seed coat	1
Wh	White hull	4
Chlorophyll aberration		
al-1 (*al-K-1*)	albino-1	6
al-2	ditto-2	5
al-3	ditto-3	5
al-4	ditto-4	1
al-5	ditto-5	4
al-6 (t)	ditto-6	5
al-7 (t)	ditto-7	4
al-8	ditto-8	1
al-9 (t)	ditto-9	6
al-10	ditto-10	3
bgl	bright green leaf	5
chl-1 (*ch-1*)	chlorina-1	3
chl-2	ditto-2	3
chl-3	ditto-3	3
chl-4	ditto-4	6
chl-5	ditto-5	1
chl-6	ditto-6	1
chl-7 (t)	ditto-7	6
chl-8	ditto-8	8
chl-9	ditto-9	8
chl-10	ditto-10	2
chs-1 (t)	chlorosis caused by low temperature-1(17°C)/$chs\text{-}1^A$, $chs\text{-}1^B$, $chs\text{-}1^C$	9
chs-2 (t)	ditto-2(17°C)/$chs\text{-}2^B$, $Chs\text{-}2^C$	
chs-3 (t)	ditto-3(17°C)	
chs-4 (t)	ditto-4(15°C)	
fs-1 (*fs*)	fine stripe-1	6
fs-2	ditto-2	1
fgl (*fl*)	faded green leaf	10
lgp	light green panicle and leaf	
pgl	pale green leaf	10
rfs	rolled fine striped leaf	7
st-1 (*ws-1*)	stripe-1	6
st-2 (*gw*)	ditto-2	5
st-3 (*stl*)	ditto-3	3
st-4 (*ws-2*)	ditto-4	4
st-5	ditto-5	4
v-1	virescent-1	6
v-1 (*t*)	ditto-1	3
v-2	ditto-2	3
v-3	ditto-3	6
v-4	ditto-4	11
v-5	ditto-5	3
v-6	ditto-6	1
v-7	ditto-7	3
v-8	ditto-8	8

v-9 (t)	ditto-9	11
v-10 (t)	ditto-10	5
v-11 (t)	ditto-11	7
ygl	yellow green leaf	10
ylb	yellow banded leaf blade	5
ylm	yellow leaf margin	4
yp	yellow panicle	
z-1	zebra-1	11
z-2	ditto-2	11
z-3	ditto-3	3
z-4	ditto-4	8
z-5	ditto-5	4
z-6	ditto-6	7
Small grain dwarf		
d-1	daikoku dwarf	5
d-7	heiei-daikoku or cleistogamous dwarf	7
d-11 (*d-8*)	shinkane-aikoku or nohrin 28 dwarf	4
d-13	short grained dwarf	
d-24 (t)	m-7 dwarf	
d-28 (*d-C*)	chokeidaikoku or long stemmed dwarf	11
d-30 (*d-W*)	waisei-shirasasa dwarf	2
d-58 (t)	small grained dwarf	
Tillering dwarf		
d-3	bunketsu-waito tillering dwarf/duplicate or triplicate	4
d-4	ditto	6
d-5	ditto	2
d-10 (*d-15, d-16*)	kikeibanshinriki or toyohikaribunwai dwarf	1
d-14 (*d-10*)	kamikawabunwai tillering dwarf	3
d-17 (t)	slender dwarf	
d-27 (*d-t*)	bunketsuto tillering dwarf	11
d-33 (*d-B*)	bonsaito dwarf	12
Malformed dwarf		
d-2	ebisu dwarf	4
d-6 (*d-34*)	ebisumochi dwarf or tankanshirasasa dwarf	7
d-18^{h}	hosetsu-waisei or akibare dwarf/*d-18*^{k}	1
d-19 (t)	kamikawa dwarf	
d-20	hayayuki dwarf	3
d-21	aomorimochi-14 dwarf	6
d-23 (t)	ah-7 dwarf	
d-26 (t)	7237 dwarf	1
d-29 (*d-K-1*)	short uppermost internode dwarf	2
d-31	Taichung-155-irradiated dwarf	4
d-32 (*d-K-4*)	dwarf Kyushu-4	2
d-42 (t)	liguleless dwarf	4
d-51 (*d-K-8*)	dwarf Kyushu-8	8
d-52 (*d-K-2*)	ditto-2	3
D-53 (*D-K-3*)	ditto-3	11
d-54 (*d-K-5*)	ditto-5	1
d-55 (*d-K-6*)	ditto-6	1
d-56 (*d-K-7*)	ditto-7	3

d-57[*d*(*x*)]	dwarf	9
Semidwarf		
d-9	Chinese dwarf	6
d-12(=*d-50*(t))	yukara dwarf or fukei 71 dwarf	
d-18^{h}	kotaketamanishiki dwarf/d-18^{h}	1
d-22(t)	jokei 6549 dwarf	
d-35(t)	tanginbozu dwarf	
d-49(t)	reimei dwarf	
d-59(t)	dwarf (DM107-4)	
d-60[*sd*(t)]	ditto (Hokuriku 100)	7
sd-1(*d-47*)	dee-geo-woo-gen dwarf	1
sd-2	semidwarf-2 (CI11033)	
sd-3	ditto-3 (CI19858)	
sd-4	ditto-4 (CI11034)	
sd-5	ditto-5 (Short Labelle)	
sd-6(t)	ditto-6 (R-34)	
sd-7(t)	ditto-7 (D56-31)	
Awn		
An-1	Awn-1/duplicate or triplicate	4
An-2	Awn-2	5
An-3	Ditto-3	3
An-4(t)	Ditto-4	8
Lemma and palea		
aph	apiculus hairs	6
bd-1	beaked lemma/duplicate	
bd-2	ditto	
clw	claw shaped spikelet	
dp-1	depressed palea-1	6
dp-2	ditto-2	9
eg	extra glume	1
g-1(*g*)	long sterile lemmas-1	7
Su-g-1	Suppressor for long sterile lemmas	
G-2(*Gm, Gl*)	Long sterile lemmas-2	
Hg	Hairy glume	3
lp-1	long palea/duplicate	7
lp-2	ditto	
mls-1	malformed lemma/duplicate	
mls-2	ditto	
Th	Hard threshability	
tri	triangular hull	2
Spikelet and grain		
cps	compact panicle sterile	
ge	giant embryo	7
lgt	long twisted grain	1
lhs-1(=*lhs-2, op*)	leafy hull sterile	3
Lk-f	'Fusayoshi' long grain	3
lk-i	'IRAT 13' long grain	4
Mi	Minute grain	3
mp-1	multiple pistil-1	1
mp-2	ditto-2	6

oms	open hull male sterile	
ops	open hull sterile	5
Ph=Bh-c (Po)	Phenol staining	4
rk-1	round kernel-1	4
rk-2	ditto-2	10
Sdr-a (Sd)	Seed dormancy/complementary	
Sdr-b	Ditto	
Sg	Permeability of testa to water	
sh-1	shattering-1	11
sh-2	ditto-2	1
Sh-3	Ditto-3	4
Sk	Scented kernel	
Un-a	Uneven grain/complementary	6
Un-b	Ditto	7
Endosperm		
ae-1	amylose extender-1	
ae-2 (t)	ditto-2	
alk	alkali degeneration	6
Am (t)	High amylose	
du-1	dull endosperm-1	10
du-2	ditto-2	
du-3	ditto-3	
du-4	ditto-4	12
du-5	ditto-5	
esp-1	endosperm storage protein-1	7
esp-2	ditto-2	11
esp-3	ditto-3	11
Esp-4	Ditto-4	
flo-1	floury endosperm-1	5
flo-2	ditto-2	
flo-3 (t)	ditto-3	4
Gt (t)	High gelatinization temperature	
H (t)	Hardness of cooked rice	
lam (t)	low amylose endosperm	9
shr-1	shrunken endosperm-1/*shr-1^{s}*, *shr-1^{a}*	1
shr-2	ditto-2	8
sug (su)	sugary endosperm	8
wx, Wx	glutinous endosperm/*wx^{op}*, Waxy protein/*Wx^{a}*, *Wx^{b}*	6
Burlush-like Panicle		
Bp	Burlush-like panicle	9
Dn-1 (Dn)	Dense panicle-1	9
Dn-2	Ditto-2	
dn-3	ditto-3	
lax (lx)	lax panicle	1
lhd	leafy head	
nl-1	neck leaf-1	5
nl-2	ditto-2	5
np	nude panicle	
Pd	Pendant panicle	
Shp-1 (Ex)	Sheathed panicle-1	1

shp-2	ditto-2	
Shp-3 (Ga)	Ditto-3/complementary	5
Shp-4 (Gb)	Ditto	3
sp	short panicle	11
spr-1	spreading panicle-2	4
Spr-2	Ditto-2	
Spr-3 (t)	Ditto-3	4
Mode of branching		
Cl	Clusterd spikelets	6
ri	verticillate spikelet	5
Ur-1 (Ur)	Undulate rachis-1	6
ur-2	ditto-2	8
Culm		
bc-1	brittle culm-1	3
bc-2	ditto-2	
bc-3	ditto-3	2
bc-4	ditto-4	6
dw-1 (fh-1)	deep water tolerance/duplicate	6
dw-2 (fh-2)	ditto	
dw-3 (t)	ditto-3	
er (o)	erect growth habit	5
Esb-a	Extra schlenchymatous band in stem/complementary	
Esb-b		
eui	elongated uppermost internode	5
fc-1	fine culm-1	3
fc-2 (t)	ditto-2	6
la	lazy growth habit	11
Nd	Early nodal differentiation	
Nr-1	Nodal rooting/complementary	
Nr-2	Ditto	
rcn-1	reduced culm number-1	6
rcn-2	ditto-2	4
rcn-3	ditto-3	
ts-a	twisted stem/complementary	1
ts-b	ditto	
Leaf		
aul	auricleless	4
dl (lop)	drooping leaf	3
drp-1	dripping-wet leaf	4
drp-2	ditto-2	9
drp-3	ditto-3	3
drp-4	ditto-4	3
drp-5 (t)	ditto-5	4
drp-6 (t)	ditto-6	6
drp-7 (t)	ditto-7	11
drp-8 (t)	ditto-8	4
Fsc (Fc)	Fuscoid cells attached to vascular bundles	
gl-1	glabrous leaf and hull/duplicate	5
gl-2	ditto	
Hl-a	Hairly leaf/complementary	6

Hl-b	Ditto	
lg	liguleless/lg^a	4
nal-1	narrow leaf-1/duplicate or triplicate	4
nal-2	ditto	11
nal-3 (*nal-2*)	ditto-3	12
nal-4 (*nal*)	ditto-4	4
nal-5 (*nal-1*)	ditto-5	4
Nal-6 (t)	Ditto-6	3
rl-1	rolled leaf-1	1
rl-2	ditto-2	4
rl-3 (*rl-1*)	ditto-3	12
rl-4 (*rl-2*)	ditto-4	1
rl-5 (*rl-3*)	ditto-5	3
rl-6 (t)	ditto-6	7
Leaf spot		
bl-1	brown leaf spot-1	2
bl-2 (*blm*)	ditto-2	6
bl-3	ditto-3	6
bl-4	ditto-4	3
bl-5	ditto-5	
bl-6	ditto-6	
spl-1 (*sl*)	spotted leaf-1	12
spl-2	ditto-2	2
spl-3	ditto-3	3
spl-4	ditto-4	6
spl-5	ditto-5	7
spl-6	ditto-6	1
spl-7	ditto-7	5
spl-8 (*bl-8*)	ditto-8	5
spl-9	ditto-9	
ysl	yellow leaf spot	
zn	zebra necrosis	6
Root		
rt	root growth inhibition	
Heading date		
Ef-1 (=*Ef-2*)	Earliness-1/$Ef\text{-}1^a$, $Ef\text{-}1^b$, $Ef\text{-}1^r$, $Ef\text{-}1^x$	10
m-Ef-1	modifier for $Ef\text{-}1/m^a\text{-}Ef\text{-}1$, $m^b\text{-}Ef\text{-}1$	7
E-1	Heading date-1	
E-2	Ditto-2	
E-3	Ditto-3	
lf-1	late flowering-1	
lf-2	ditto-2	
Se-1 (*Lm, Lf, Rs, Fl*)	Photosensitivity-1/$Se\text{-}1^e$, $Se\text{-}1^n$, $Se\text{-}1^t$, $Se\text{-}1^s$, $Se\text{-}1^u$	6
se-2	ditto-2	7
Se-3 (t)	Ditto-3	
i-Se-1	recessive inbibitor for photosensitivity (*Se-1*)	
En-Se-1 (t)	Enhancer for photosensitivity (*Se-1*)	6

Sterility

as	asynapsis	
ds-1	desynapsis-1	
ds-2 (t)	ditto-2	
ds-3 (t)	ditto-3	
ds-4 (t)	ditto-4	
ds-5 (t)	ditto-5	
ds-6 (t)	ditto-6	
ds-7 (t)	ditto-7	
ds-8 (t)	ditto-8	
ds-9 (t)	ditto-9	
ds-10 (t)	ditto-10	
ds-11 (t)	ditto-11	
fes-1	female sterile-1/duplicate	
fes-2	ditto	
Fes-3 (*Fes-2*)	Ditto-3	
lt (t)	gametic lethal/lt^m	11
ms-1 (*sf*)	male sterile-1	6
ms-2 (*ms-d*)	partial male sterile-2	
ms-3 (*ms-1*)	ditto-3	
ms-4 (*ms-2*)	ditto-4	
ms-5 (*ms-3*)	ditto-5	
ms-6 (*ms-4*)	ditto-6	
ms-7	male sterile-7	3
ms-8	ditto-8	7
ms-9	ditto-9	6
ms-10	ditto-10	9
ms-11	ditto-11	
ms-12	ditto-12	
ms-13	ditto-13	
ms-14	ditto-14	5
ms-15	ditto-15	
ms-16	ditto-16	
ms-17	ditto-17	2
ms-18	ditto-18	1
s-a-1 (*s-1*)	hybrid sterility-a/gametophytic F_1 sterility/duplicate	6
s-a-2 (*s-2*)	ditto	
s-c-1	hybrid seterility-c	6
s-c-2	ditto	4
s-d-1	hybrid sterility-d	6
s-d-2	ditto	
s-e-1	hybrid sterility-e	3
s-e-2	ditto	4
S-A-1 (*A-1*)	Hybrid sterility-A/sporophytic F_2 sterility/duplicate	6
S-A-2 (*A-2*)	Ditto	
S-B-1 (*B-1*)	Hybrid sterility-B	
S-B-2 (*B-2*)	Ditto	
S-1	Hybrid sterility-1/$S\text{-}1^a$/sporo-gametophytic interaction	6
S-2	Ditto-2/$S\text{-}2^a$	

S-3	Ditto-3/*S-3*^{a}	11
S-4	Ditto-4/*S-4*^{a}	
S-5	Ditto-5/*S-5*^{n}, *S-5*^{j}, *S-5*^{i}, *S-5*^{p}	6
S-6	Ditto-6/*S-6*	6
Hybrid weakness		
D-a(*D-1*)	Dominant lethal/complementary	
D-b(*D-2*)	Ditto	
hca-1	hybrid chlorosis-a/complementary	
hca-2	ditto	
Hwa-1(*L-1-a*)	Hybrid weakness-a	
Hwa-2(*L-1-b*)	Ditto	
hwb-1(*w-a*)	F_2 weakness-b/complementary	
hwb-2(*w-b*)	ditto	
Hwc-1(*L-2-a*)	Hybrid weakness-c	
Hwc-2(*L-2-b*)	Ditto	
Gametophyte gene		
ga-1	gametophyte gene-1	6
ga-2	ditto-2	3
ga-3	ditto-3	3
ga-4(*ga-A*)	ditto-4	6
ga-5(*ga-B*)	ditto-5	6
ga-6	ditto-6	4
ga-7	ditto-7	1
ga-8	ditto-8	1
ga-9	ditto-9	1
ga-10(t)	ditto-10	4
Cytoplasmic male sterility : Cytoplasm		
[*cms-bo*]	'Chinsurah boro II' cytoplasm	
[*cms-ld*]	'Lead rice' ditto	
[*cms-TA*]	'TA820' ditto	
[*cms-CW*]	'Chinese wild rice' ditto	
[*cms-UR89*]	'UR89F' ditto	
[*cms-UR102*]	'UR102F' ditto	
[*cms-UR104*]	'UR104F' ditto	
[*cms-UR27*]	'UR27F' ditto	
[*cms-UR106*]	'UR106F' ditto	
[*cms-WA*]	'WA-group' ditto	
[*cms-HL*]	'HL-group' ditto	
[*cms-ak*]([*cms-jp*])	'Akebono' ditto	
Fertility restorer		
Rf-1	Pollen fertility restoration/*Rf-1*^{a}, *Rf-1*^{b}, *Rf-1*^{c}, *Rf-1*^{d}, *Rf-1*^{e}	10
Rf-2(*Rf-x*)	Ditto-2	
Rf-a, b, c	Ditto/complementary	
Rf-a, b, c, d	Ditto/complementary	
Rf-ak(*Rf-j*)	Ditto-ak	
Fungal and bacterial disease resistance		
Ce	*Cercospora* resistance	
He	*Helminthosporium oryzae* resistance	

Pi-a	*Pyricularia oryzae* resistance-a	11
Pi-b (*Pi-s*)	Ditto-b	2
Pi-f	Ditto-f	11
Pi-i	Ditto-i	6
Pi-k	Ditto-k/*Pi-k*^{s}, *Pi-k*^{p}, *Pi-k*^{m}, *Pi-k*^{h}	11
Pi-sh	Ditto-sh	
Pi-t	Ditto-t	
Pi-ta (=*sl*)	Ditto-ta/*Pi-ta*^{2}, *Pi-ta*^{n}	9
Pi-z	Ditto-z/*Pi-z*^{t}	6
M-Pi-z (*Rb-6*)	Modifier for *Pi-z*	11
Pi-is-1 (*Rb-4*)	*Pyricularia oryzae* resistance-is/cumulative	11
Pi-is-2 (*Rb-5*)	Ditto	
Pi-se-1 (*Rb-1*)	*Pyricularia oryzae* resistance-se/additive	11
Pi-se-2 (*Rb-2*)	Ditto	
Pi-se-3 (*Rb-3*)	Ditto	
Sc-1	*Sclerotium oryzae* resistance/duplicate	
Sc-2	Ditto	
Xa-1 (*Xe*)	*Xanthomonas campestris* pv. *oryzae* resistance-1/*Xa-1*^{h}	4
Xa-2	Ditto-2	4
Xa-3 (*Xa-w*, *4*^{b}, *6*, *9*)	Ditto-3	
Xa-4 (*Xa-4*^{a})	Ditto-4	11
xa-5	ditto-5	5
Xa-7	Ditto-7	
xa-8	ditto-8	
Xa-10	Ditto-10	11
Xa-11 (*Xa-pt*)	Ditto-11	
Xa-12 (*Xa-kg*)	Ditto-12/*Xa-12*^{h}	4
xa-13	ditto-13	5
Xa-14	Ditto-14	4
xa-16	ditto-16	
Xa-17	Ditto-17	
Xa-18	Ditto-18	
xa-19	ditto-19	
xa-20	ditto-20	
Virus and mycoplasma disease resistance		
Bsv (*Bs*)	Black streaked dwarf resistance	
Gsv (*Gs*)	Grassy stunt resistance	
Hbv	*Hoja blanca* resistance	
Stv-a	Stripe disease resistance/complementary	6
Stv-b	Ditto/*Stv-b*^{i}	8
Tuv-a	Tungro virus resistance/complementary	
Tuv-b	Ditto	
Ydv	Yellow dwarf resistance	
Insect resistance		
Bph-1	Brown planthopper resistance-1	4
bph-2	ditto-2	4
Bph-3	Ditto-3	10
bph-4	ditto-4	10

bph-5	ditto-5	
Bph-6	Ditto-6	
bph-7	ditto-7	
bph-8	ditto-8	
Bph-9	Ditto-9	
I-Bph-1	Inhibitor for *Bph-1*	
Glh-1	Green leafhopper resistance-1	
Glh-2	Ditto-2	
Glh-3	Ditto-3	10
glh-4	ditto-4	
Glh-5	Ditto-5	
Glh-6	Ditto-6	5
Glh-7	Ditto-7	
Gm-1(gm, pd)	Gall midge resistance-1	
Gm-2	Ditto-2	
Grh-1	Green leafhopper resistance/duplicate or complementary	
Grh-2	Ditto	
Sb	Stem borer resistance	
Sm	Stem maggot resistance/incomplete dominance	
Wph-1(Wbph)	White-backed planthopper resistance-1	
Wph-2	Ditto-2	
Wph-3	Ditto-3	
wph-4	ditto-4	
Wph-5	Ditto-5	
Zlh-1	Zigzag leafhopper resistance-1	
Zlh-2	Ditto-2	
Zlh-3	Ditto-3	
Isozyme		
Acp-1	Acid phosphatase-1/*Acp-1^0*, *Acp-1^1*, *Acp-1^2*, *Acp-1^3*	12
Acp-2	Ditto-2/*Acp-2^0*, *Acp-2^1*	12
Acp-3	Ditto-3/*Acp-3^0*, *Acp-3^1*	
Acp-4	Ditto-4/*Acp-4^1*, *Acp-4^2*	
Adh-1	Alcohol dehydrogenase-1/*Adh-1^0*, *Adh-1^1*, *Adh-1^2*, *Adh-1^3*	11
Amp-1(Lap-1)	Aminopeptidase-1/*Amp-1^0*, *Amp-1^1*, *Amp-1^2*, *Amp-1^3*, *Amp-1^4*, *Amp-1^5*, *Amp-1^6*	2
Amp-2(Alap-A)	Ditto-2/*Amp-2^1*, *Amp-2^2*, *Amp-2^3*, *Amp-2^4*	8
Amp-3(Amp-1)	Ditto-3/*Amp-3^0*, *Amp-3^1*, *Amp-3^2*, *Amp-3^4*, *Amp-3^5*, *Amp-3^6*	6
Amp-4	Ditto-4/*Amp-4^1*, *Amp-4^2*, *Amp-4^3*	8
β-Amy-1(t)	β-Amylase isozyme/*β-Amy-1^0*, *β-Amy-1^2*, *β-Amy-1^3*, *β-Amy-1^4*	7
Cat-1	Catalase-1/*Cat-1^1*, *Cat-1^2*, *Cat-1^3*	6
Dia-1(t)	Diaphorase-1/*Dia-1^1*, *Dia-1^2*	
Dia-2(t)	Ditto-2/*Dia-2^1*, *Dia-2^2*	
Enp-1	Endopeptidase/monomer/*Enp-1^0*, *Enp-1^1*	6
Est-1	Eeterase-1/*Est-1^0*, *Est-1^1*	3, 4 or 7
Est-2	Ditto-2/*Est-2^0*, *Est-2^1*, *Est-2^2*	6
Est-3	Ditto-3/*Est-3^1*, *Est-3^2*	9

Est-4	Ditto-4/*Est-4*^{0}, *Est-4*^{1}	
Est-5	Ditto-5/*Est-5*^{0}, *Est-5*^{1}, *Est-5*^{2}	1
Est-6	Ditto-6/*Est-6*^{0}, *Est-6*^{1}	
Est-7	Ditto-7/*Est-7*^{0}, *Est-7*^{1}	
Est-8	Ditto-8/*Est-8*^{0}, *Est-8*^{1}	
Est-9 (*Est-cl*)	Ditto-9/*Est-9*^{1}, *Est-9*^{2}	7
Fdp-1	Fructose-1, 6-diphosphatase-1/*Fdp-1*^{0}, *Fdp-1*^{1}, *Fdp-1*^{2}	11
G6pd-1 (t)	Glucose-6-phosphate dehydrogenase-1	
Gdh-1	Glutamate dehydrogenase-1/*Gdh-1*^{1}, *Gdh-1*^{2}	3
Got-1	Aspartate aminotransferase-1/*Got-1*^{1}, *Got-1*^{2}, *Got-1*^{3}	1
Got-2	Ditto-2/*Got-2*^{1}, *Got-2*^{2}	6
Got-3	Ditto-3/*Got-3*^{1}, *Got-3*^{2}	2
Icd-1 (*Idh-a*)	Isocitrate dehydrogenase-1/*Icd-1*^{1}, *Icd-1*^{2}, *Icd-1*^{3}	1
Mal-1	Malate dehydrogenase (NADP)-1	7
Mdh-1	Malate dehydrogenase (NAD)-1	
Pgd-1	Phosphogluconate dehydrogenase-1/*Pgd-1*^{1}, *Pgd-1*^{2}, *Pgd-1*^{3}	11
Pgd-2	Ditto-2/*Pgd-2*^{1}, *Pgd-2*^{2}	6
Pgi-1	Phosphoglucose isomerase-1/*Pgi-1*^{0}, *Pgi-1*^{1}, *Pgi-1*^{2}, *Pgi-1*^{3}	3
Pgi-2	Ditto-2/*Pgi-2*^{1}, *Pgi-2*^{2}, *Pgi-2*^{3}, *Pgi-2*^{4}	6
Pgi-3	Ditto-3/*Pgi-3*^{0}, *Pgi-3*^{1}	
Pox-1 (*Px*, *Pe*)	Peroxidase-1/*Pox-1*^{0}, *Pox-1*^{1}, *Pox-1*^{2}	5
Pox-2	Ditto-2/*Pox-2*^{0}, *Pox-2*^{1}	12
Pox-3	Ditto-3/*Pox-3*^{1}, *Pox-3*^{2}	3 or 4
Pox-4	Ditto-4/*Pox-4*^{1}, *Pox-4*^{2}	3 or 4
Pox-5	Ditto-5/*Pox-5*^{1}, *Pox-5*^{2}	6
Sdh-1	Shikimate dehydrogenase-1/*Sdh-1*^{1}, *Sdh-1*^{2}, *Sdh-1*^{3}, *Sdh-1*^{4}	12
Sud-1 (t)	Succinate dehydrogenase-1	
Sud-2 (t)	Succinate dehydrogenase-2	
Sud-3 (t)	Succinate dehydrogenase-3	
Tpi-1 (t)	Triosephosphate isomerase-1	
Xdh-1 (t)	Xanthine dehydrogenase-1/*Xdh-1*^{1}(t), *Xdh-1*^{2}(t)	
M-Pox-1 (*Mpx-1*)	Modifier for *Pox-1*/*M-Pox-1*^{0}, *M-Pox-1*^{1}	5
R^{4c}_{LB}	Regulator gene for peroxidase	
R^{4c}_{LS}	Ditto	
Rcp	Receptor gene for peroxidase/*Rcp*^{2A}, *Rcp*^{4A}	
Reg-1^{2A}	Regulator gene for peroxidase-1	
Reg-2^{4A}	Ditto-2	
Chemical and stress tolerance		
bzs	bentazon susceptibility	
Cts	Cold tolerance at seedling stage	
hpr-1	hydroxyproline resistance-1	
hpr-2 (t)	ditto-2	
hpr-3 (t)	ditto-3	
pcs	pentachlorobenzyl alcohol susceptibility	
prs	propanil susceptibility	

usages such as genes for heading or flowering date and sterility characters. They are now under discussions among related scientists.

Future problems

As for the 12 linkage groups, identification among the different series has mostly been achieved by the use of primary trisomics. However, it is difficult to consolidate the Indian linkage groups published by MISRO[159] in the maps because of the shortage of common markers. In particular, further efforts are needed for the identification of gene system used in color characters[105,106].

Position of centromere is still obscure in all maps for the absence of approriate cytological markers, excepting the efforts by Sato *et al*[251]. However, karyotype of 12 chromosomes was clearly identified by the application of new methods[26,53].

In many plant species including rice, genetic maps comprising conventional markers have developed rather steadily during a considerable period. Economically inportant loci such as disease and insect resistance, heading time, grain quality and male sterile genes were located on the maps. Therefore, the use of these maps is important for various researches in conventional genetics and plant breeding. Recently 33 loci of isozyme genes were alloted to the ten chromosomes (Table 4) and used as good selection markers as in the case of *Pgi-2*[59,223].

On the other hand, the use of restriction fragment length polymorphism (RFLP) mapping first applied for human genetics in 1980[9] opened the way to use for many crop species and made it possible to construct detailed linkage maps quickly[157,347]. Thus it provides a more direct method for selecting desirable gene via the tight linkage with RFLP markers[313].

Therefore genetic maps that integrate conventional and biochemical markers such as isozyme, RFLP and cloned genes will be quite valuable in future genetics and breeding. For this purpose, the linkage data related to isozyme genes which can be located commonly in conventional and molecular maps, will be used effectively. In addition, near-isogenic gene mapping techniques can be applied for the quick detection of the loci of specific markers derived from the donor parent[169]. Two series of isogenic lines for dwarfness and the linkage markers are now being utilized for our collaborate research work with Cornell University.

Mapping of quantitative trait loci (QTLs) provides precious information for establishing breeding programmes and extensive co-operation among many institutions will be desirable for this purpose by using common materials such as recombinant inbreds, double haploids and backcross families under various environmental conditions[10].

The recent developing of pulse field gel electrophoresis and cloning to artificial yeast chromosomes will facilitate the analysis of large pieces of DNA and chromosome walking and jumping can be used for isolation of the target gene[108]. It is known that the relationship between genetic and physical chromo-

somal maps is not always linear. The use of *in situ* hybridization techniques is essential for the analysis of physical location on the chromosome[37,137]. Gene tagging by the use of RFLP analysis is important for isolating and cloning genes whose products are unknown such as genes for disease resistance or stress tolerance. RFLP, VNTR (variable number of tandem repeat) and RAPD (randam amplified polymorphic DNA markers) will be used for markers to evaluate the exotic germplasms. Recently transformation techniques have been available for inserting the DNA back to examine the gene function and provide new breeding tools[219].

Thus the linkage studies in rice are going to enter into a new era providing a sound basis for new efficient breeding techniques.

Summary

Newly constructed linkage maps of rice which include the latest information are presented. 206 lici were allotted to the twelve groups and 142 loci were positioned on the 12 chromosomes. They include the genes for economical characters such as semidwarfness, panicle and grain characters, heading habit, male sterility, disease and insect resistance and stress tolerance. 33 isozyme loci were located in ten kinds of chromosomes.

Recently the use of RFLP (restriction fragment length polymorphism) and other biochemical markers made it possible to construct new maps rapidly. Integration of conventional and molecular linkage maps is important from the stand point of the use of these data for rice genetics. Further studies on isolation and function of rice genes are important for the development of new technologies which are complemented with both molecular and conventional genetics.

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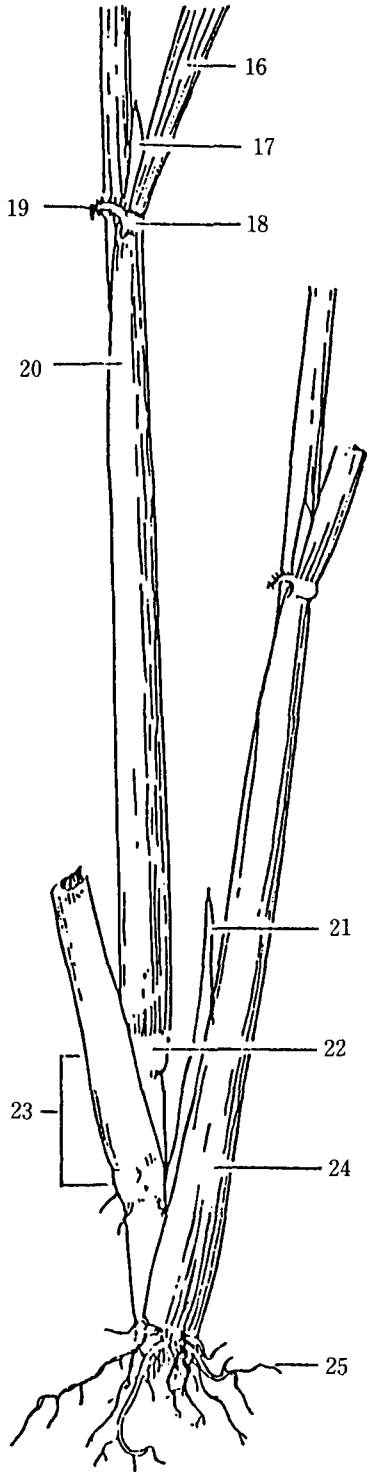
Explanation of Plate

Component parts of a rice plant

Name of parts

1. Awn
2. Apiculus
3. Lemma and palea pubescence
4. Lemma
5. Palea
6. Sterile lemmas
7. Rachilla
8. Rudimentary glumes
9. Pedicel
10. Secondary branch
11. Primary branch
12. Spikelet
13. Panicle axis
14. Flag leaf
15. Uppermost internode
16. Leaf blade
17. Ligule
18. Collar
19. Auricle
20. Leaf sheath
21. Prophyllum
22. Pulvinus
23. Internode
24. Tiller
25. Adventitious roots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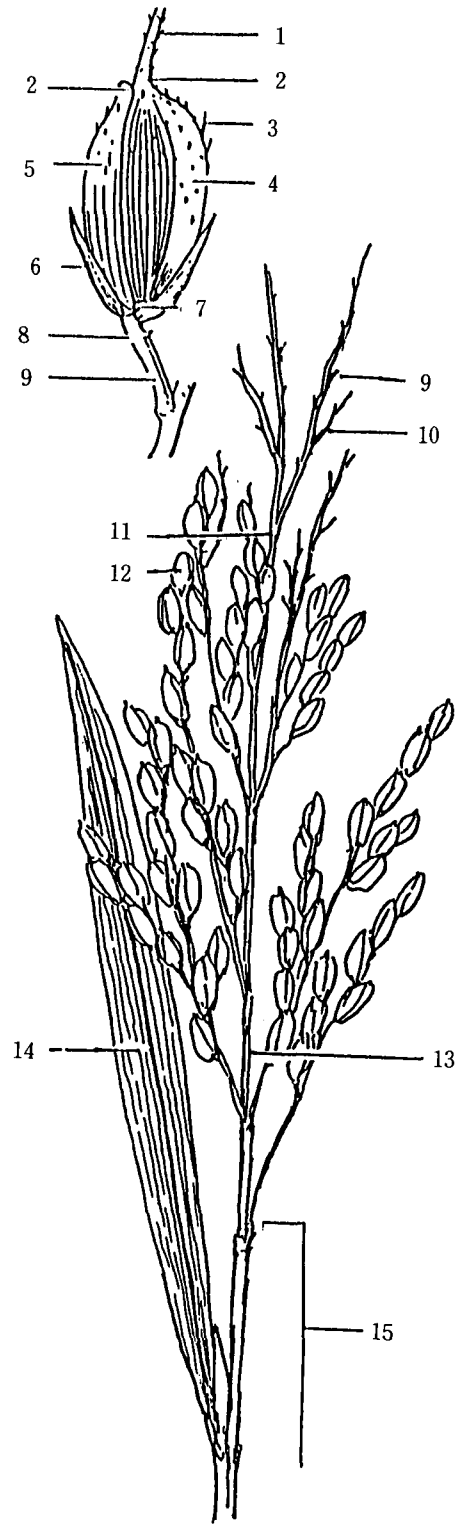
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