Cytogenetical Studies on *Oryza sativa* L.IX. The F₁ hybrid of *O. sativa* L.and *O. glaberrima* STEUD.*

by

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O. glaberrima STEUD. is a species which differs from *O. sativa* L. chiefly by a short ligule up to 6mm long and glabrous spikelets without awns, or less frequently, part of them with awns up to 19 mm long (7). This species, like *O. sativa* L., has 24 chromosomes in somatic cells, and at meiosis the chromosomes regularly form 12 bivalents (6). The species is found in West Africa, and is thought to have long been cultivated probably in Guinea, Camerance and Sudan (1)(7).

According to RAMANUJAM(6), cross between this species and *O. sativa* L. succeeded very easily at

the Paddy Breeding Station, Coimbatore (India), and many of the characteristics segregated in Mendelian fashion in the progeny. The glabrous nature of the glume, on which the specific difference between the two is mainly based was found to follow a multiple factor segregation.

In 1953, the authors crossed *O. glaberrima* STEUD. to *O. sativa* L. The F₁ hybrid was easily obtainable but contrary to expectation it produced no seeds. The experimental results which were reported somewhat at occasions (2), (3), (4) will be reported here in detail.

Table I. Results of artificial cross pollination between *O. sativa* L. and *O. glaberrima* STEUD., in 1953

Line No. of F ₁ in 1954	Combination of parents		Number of flowers pollinated	Number of perfect grains obtained	Number of imperfect grains obtained	Number of sterile spikelets	Percentage of fertile spikelets
79	Takasaki-mochi	× Bala Oulé(<i>O. g.</i>)	91	1	0	90	1.1
82	Kuma	× "	6	5	0	1	83.3
83	Ôzeki	× "	12	2	0	10	16.7
	Asahi	× "	12	0	0	12	0
80,81	Murasakisaikan	× "	38	13	0	25	34.2
117,118	Koganenishiki	× "	35	8	0	27	22.9
84,85	Murasakisaikan	× Malo Ba(<i>O. g.</i>)	46	5	14	27	41.3
	Takasaki-mochi	× Mouvaguin(<i>O. g.</i>)	13	0	0	13	0
88	Kuma	× "	6	2	0	4	33.0
	Ôzeki	× "	1	0	0	1	0
87	Asahi	× "	9	3	0	6	33.3
86	Murasakisaikan	× "	24	1	0	23	4.2
119	Koganenishiki	× "	20	7	0	13	35.0
120	Modoshi-mochi-kawari	× "	4	1	0	3	25.0
121	Waiseishirasasa	× "	4	1	0	3	25.0
122,123	Tankanshirasasa	× "	5	2	0	3	40.0
89-94	Takasaki-mochi	× Baladjaug(<i>O. g.</i>)	155	29	0	126	18.7
98,99	Kuma	× "	10	8	0	2	80.0
100	Ôzeki	× "	21	13	0	8	61.9
95-97	Asahi	× "	33	7	0	26	21.2
246	Baladjaug(<i>O. g.</i>)	× Norin No.18	1	0	1	0	100.0
	Modoshi-mochi-kawari	× Baradjaug(<i>O. g.</i>)	45	0	0	45	0
128,129	Tankanshirasasa	× "	10	3	0	7	30.0
124,125	Iyogasuri No. 1	× "	48	42	2	4	91.7
126	Miyazaki No. 3	× "	8	5	0	3	62.5
127	Kôyabôzu	× "	18	13	0	5	72.2
	Total (26 combinations with Japanese varieties)		676	171	17	487	27.9
154,155	Hikari-sen	× Bala Oulé(<i>O. g.</i>)	12	8	0	4	66.7
156-159	"	× Baladjaug(<i>O. g.</i>)	25	17	2	6	76.0
162	Tôgyokusai	× "	33	9	0	24	27.3
160,161	Kada	× "	71	9	0	62	12.7
185	Heenati	× Mouvaguin(<i>O. g.</i>)	12	11	0	1	91.7
	Total (5 combinations with foreign varieties)		183	64	2	97	36.6

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Table II. Germination of the hybrid seed.

Line No. of F ₁ in 1954	Combination of parents		Season in which the plants were raised	Number of seeds sown	Number of seeds germinated	Number of seedlings di- ed soon after germination	Number of selfed indi- viduals	Number of true F ₁ plants survived
79	Takasaki-mochi	× Bala Oulé	Summer	1	1	1	—	—
82	Kuma	× "	Winter	4	4	0	0	4
83	Ôzeki	× "	"	2	2	0	0	2
80	Murasakisaikan	× "	"	4	4	0	0	4
117	Koganenishiki	× "	"	4	2	0	0	2
85	Murasakisaikan	× Malo Ba	"	3	3	0	0	3
88	Kuma	× Mouvaguin	"	2	1	0	0	1
87	Asahi	× "	"	3	3	0	0	3
86	Murasakisaikan	× "	Summer	1	1	0	0	1
119	Koganenishiki	× "	"	7	5	1	0	4
120	Modoshi-mochi-kawari	× "	"	1	1	0	1	0
121	Waiseishirazasa	× "	"	1	0	—	—	—
122	Tankanshirazasa	× "	"	1	0	—	—	—
123	"	× "	"	1	0	—	—	—
89	Takasaki-mochi	× Baladjaug	Winter	4	4	0	2	2
98	Kuma	× "	Summer	2	2	1	0	1
99	"	× "	"	6	6	0	0	6
100	Ôzeki	× "	Winter	4	4	0	0	4
95	Asahi	× "	"	1	1	0	0	1
128	Tankanshirazasa	× "	Summer	1	1	0	0	1
129	"	× "	"	2	0	—	—	—
124	Iyogasuri No. 1	× "	"	8	6	0	0	6
125	"	× "	"	7	7	0	0	7
126	Miyazaki No. 3	× "	"	5	3	1	0	2
127	Kôyabôzu	× "	"	13	10	0	0	10
Total (hybrids with Japanese varieties)				88	71	4	3	64
154	Hikari-sen	× Bala Oulé	Summer	2	1	0	0	1
155	"	× "	Winter	4	4	0	0	4
159	"	× Baladjaug	"	4	4	0	4	0
162	Tôgyokusai	× "	"	4	4	0	0	4
160	Kada	× "	Summer	1	1	1	—	—
161	"	× "	"	7	5	0	0	5
185	Heenati	× Mouvaguin	Winter	4	4	1	0	3
Total (hybrids with foreign varieties)				26	23	2	4	17

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Materials

O. glaberrima STEUD. used in this study was introduced into Japan during 1953 from West Africa by Dr. I. NAGAI, to whom the authors are indebted for the seed of the following 4 varieties.

1. Variety Bala Oulé (origin: French Sudan)
2. Variety Malo Ba (Origin: French Sudan)
3. Variety Mouvaguin (origin: Casamance, French West Africa)
4. Variety Baladjaug (origin: Casamance, French West Africa)

The general appearance of these cultivated varieties of *O. glaberrima* STEUD. is somewhat similar to *O. sativa* L., though they are slightly shorter, producing rather short and wide terminal leaves. These varieties like *O. sativa* develop a fibrous root system, but unlike that species, they produce short ligules of round tip, and thin panicles with almost glabrous flower glumes (Fig. 1 and Fig. 2). The spikelets, 8.1~8.5mm long and 3.3~3.6mm wide, are not deciduous and often break off when thre-

shed at the portion between upper and lower empty glumes. These varieties are awnless, excepting var. Baladjaug which produce smooth awns of medium length. Baladjaug is also exceptional in the ripening colour of spikelets, being yellowish brown. The varieties are highly photosensitive and do not come to flower under the natural conditions of Tokyo. Under controlled short-day condition, however, they flower easily, showing enough high fertility, excepting variety Malo Ba of which fertility is not satisfactorily high.

Cultivated varieties of *O. sativa* L. used in the following hybridization experiments amounted to 17. Of these varieties, 13 were of Japan (5 normal and 8 of abnormal or mutant type), 2 were of China and the rest were of India and Ceylon.

O. sativa L. × *O. glaberrima* STEUD.

Cross was made in 1953 with these materials, usually taking the *sativa* variety on the female side. The hot water method was used for emasculation. The details of mating combinations, and the results of crossing are shown in Table I. For 26 mating combinations between Japanese varieties and *glaberrima*, 675 flowers, in total, were artifi-

cially pollinated, and a total of 188 seeds (27.9%) were produced in 22 combinations. For 5 cross combinations between foreign varieties and *glaberrima*, 153 flowers were artificially pollinated, and 56 seeds (36.6%) were produced. In both cases, a few of the seeds thus obtained, however, proved later as self-fertilized products (Table II).

F₁ plants

The seeds of some cross combinations were sown in the winter season of 1953~1954, and those of others in the summer of 1954. The germination records are summarized in Table II. Eighty one true F₁ plants were thus obtained out of 26 different combination of parents. The plants of the winter culture grown in a green house were brought at the end of February under a controlled short-day condition. The plants of the summer culture were brought under the short-day condition at the end of July, leaving some plants under natural conditions throughout, as controls.

Table III a and b show, as examples, the results of observations made on the hybrid of different parental combinations grown in the winter season, compared with their parents (c. f. Fig. 3, Fig. 4 and Fig. 5). Table IV and Table V show the results of measurements made on the hybrid grown in the green house. From these tables the following may

Fig. 1. The ligule of *O. glaberrima* (Bala Oulé).

Fig. 2. The panicle and the terminal leaf blade of *O. glaberrima* (Bala Oulé).

Fig. 3. *O. sativa* (Hikari-sen).

Fig. 4. The F₁ of Hikari-sen and Bala Oulé.

Fig. 5. *O. glaberrima* (Bala Oulé)

Table III. Parental contrasting characteristics

Characteristics		Bala Oulé(<i>O. g.</i>)	Malo Ba(<i>O. g.</i>)	Mouvaguin(<i>O. g.</i>)	Baladjoug(<i>O. g.</i>)
Awn	length	awnless or trace	awnless or trace	awnless or trace	medium length
	density	rare	rare	rare	dense
	colour	—	—	—	red purple
Spikelets	length and width	long, fairly wide	long, wide	long, fairly wide	long, fairly wide
	glume tip-colour	base red purple	colourless	colourless	red purple
	ripening	blackish brown	black	blackish brown	yellowish brown
	flower glume-colour	—	—	—	—
	glume-hairs	trace	trace	trace	trace
	hulled grain-colour	red	red	red (white)	red
First normal leaf-blade	deciduousness	not deciduous	not deciduous	not deciduous	not deciduous
	Pollen dispersion	normal	normal	normal	normal
	Stigma-colour	blackish purple	blackish purple	blackish purple	blackish purple
Terminal leaf-blade	length and width	rather long, wide	long, wide	medium, rather wide	long, wide
	inclination	fairly large	large	large	large
	blade-length	short	short	short	short
	blade-width	wide	wide	fairly wide	wide
Stem	Shape of ligules	short, round end	short, round end	short, round end	short, round end
	Colour of ligules	slightly purple	light purple brown	light purple brown	light purple brown
	Leaf-blade-colour	colourless	colourless	colourless	colourless
	Leaf-sheath-colour	base purple	purple	purple	colourless
Stem	internode-colour	colourless	purplish	purplish	purplish
	node-colour	colourless	colourless	colourless	colourless
Plant height		normal	normal	normal	normal
Type of panicle		compact-spread	compact-spread	compact	compact-spread
Fertility		high	not so high	high	high
Earing under natural conditions		not come to ear	not come to ear	not come to ear	not come to ear
Surviving the winter		not survive	not survive	not survive	not survive

Table III. Parental contrasting characteristics

Characteristics		Kuma × Bala Oulé	Ôzeki × Bala Oulé	Kuma × Mouvaguin
Awn	length	long	long	long
	density	dense	medium	medium
	colour	red purple	light red purple	red purple
Spikelets	length and width	long, fairly wide	long, fairly wide	long, fairly wide
	glume tip-colour	red purple	light red purple	red purple
	flower glume-colour	yellowish brown	yellowish brown	yellowish brown
	glume-hairs	long, dense	long, dense	long, dense
	hulled grain-colour	—	—	—
	deciduousness	easy	easy	easy
First normal leaf-blade	Pollen dispersion	difficult	difficult	difficult
	Stigma-colour	purple	purple	purple
	length and width	medium, wide	medium, rather wide	medium, medium
Terminal leaf-blade	inclination	medium	medium	medium
	blade-length	medium	long	rather short
	blade-width	wide	wide	medium
	Shape of ligules	medium, acute, not split	medium, acute, not split	rather short, acute, not split
Colour of ligules		light purplish brown	light purplish brown	light purplish brown
Leaf-blade-colour		colourless	colourless	colourless
Leaf-sheath-colour		base purple	base purple	base purple
Stem	internode-colour	purple	purple	light purple
	node-colour	—	—	light purple
Plant height		normal	normal	normal
Type of panicle		compact-semispread	rather spread	rather spread
Fertility		sterile	sterile	sterile
Earing under natural conditions		come to ear late	not come to ear	come to ear
Surviving the winter		survive well	survive well	survive well

and their manifestation in F₁ hybrids, A.

Kuma(O. s.)	Ôzeki(O. s.)	Asahi(O. s.)	Hikari-sen(O. s.)	Heenati(O. s.)
medium length	short	medium length	short	trace
sparse	sparse	sparse	sparse	sparse
blackish purple	colourless	colourless	colourless	colourless
short, wide	short, wide	short, wide	long, narrow	short, rather narrow
blackish purple	colourless	colourless	colourless	colourless
blackish purple	yellowish brown	yellowish brown	yellowish brown	dark brown
long, dense	long, moderate	long, moderate	medium length, dense	short, moderate
white	white	white	white	red
normal	normal	normal	normal	normal
normal	normal	normal	normal	normal
purple	colourless	colourless	colourless	colourless
short, narrow	short, medium	short, narrow	long, rather narrow	long, medium
small	small	small	large	medium
—	rather long	medium	medium	—
—	medium	rather wide	narrow	—
long, acute	long, acute	long, acute	very long, acute	long, acute
—	colourless	colourless	colourless	colourless
colourless	colourless	colourless	colourless	colourless
base purple	colourless	colourless	colourless	light purple
purple streaks	colourless	colourless	colourless	colourless
—	colourless	colourless	colourless	colourless
normal	rather low	rather low	normal	normal
compact	compact	compact	compact	compact
high	high	high	high	high
come to ear	come to ear	come to ear	come to ear	come to ear
survive	survive	survive	survive	survive

and their manifestation in F₁ hybrids, B.

Asahi × Mouvaguin	Ôzeki × Baladjaug	Asahi × Baladjaug	Hikari-sen × Bala Oulé	Heenati × Mouvaguin
long	long	long	medium	long
dense	dense	dense	sparse	dense
red purple	light red purple	light red purple	light red purple	light red purple
long, fairly wide	long, fairly wide	long, fairly wide	long, rather narrow	long, rather narrow
red purple	light red purple	light red purple	red purple	light red purple
yellowish brown	yellowish brown	yellowish brown	yellowish brown	yellowish brown
long dense	long, dense	long, dense	medium, dense	medium, dense
—	—	—	—	—
easy	easy	easy	easy	easy
difficult	difficult	difficult	difficult	difficult
colourless	colourless	purple	purple	—
medium, medium	medium, wide	medium, medium	long, medium	—
large	large	medium	large	—
rather short	medium	medium	long	long
wide	wide	wide	wide	rather wide
medium, acute, not split	medium, acute, not split	medium, acute, not split	long, acute, not split	medium, acute, not split
—	colourless	colourless	—	colourless
colourless	colourless	colourless	colourless	colourless
—	colourless	colourless	base purple	base purple
purple	purple	purple	colourless	light purple
colourless	colourless	—	colourless	colourless
normal	normal	normal	normal	normal
rather spread	compact-semispread	rather spread	rather spread	rather spread
sterile	sterile	sterile	sterile	sterile
come to ear	come to ear	come to ear	not come to ear	come to ear
survive well	survive well	survive well	survive well	survive well

be pointed out :

The F_1 spikelets develop the awn more conspicuously than the parents, and they produce it even when both of the parents are entirely or almost awnless (Fig. 6 and Fig. 7). Japanese varieties of *sativa* had long hairs on the glume, while those of Chinese had rather short glume hairs, and those of India and Ceylon had short glume hairs. The glume of *glaberrima* has only very minute hairs. The F_1 plants between Japanese varieties of *sativa* and *glaberrima* produce dense long hairs, and those between the foreign varieties of *sativa* and *glaberrima* produce rather close short hairs. The ripening colour of the glume of normal varieties of *sativa* used is either yellowish brown or blackish purple, and the corresponding colour for *glaberrima* is black or blackish brown with the exception of Baladjaug in which glume is yellowish brown. The ripening colour of the hybrid glume, which is sterile, is always yellowish brown failing to produce any strong colour.

The spikelet of *glaberrima* is long and fairly wide, while it is short and wide for Japanese varieties, and short and somewhat narrow for the Ceylon

Table. IV. Some measurements on the parents and hybrids.

	Date of heading	Total length cm.	Panicle length cm.	Number of ears	Terminal leaf-blade length cm.	Terminal leaf-blade width cm.	Ligule length mm.
Ozeki	8/IV	51.2	16.5	5	31.5	1.3	18.0
Takasaki-mochi	5/IV	64.5	17.2	6	33.9	1.4	19.0
Asahi	6/IV	57.5	14.9	5	26.9	1.5	14.0
Kogane-nishiki	10/IV	49.9	17.5	4	24.7	1.3	11.5
Hikari-sen	24/III	71.9	21.0	9	26.4	1.1	32.5
Togyokusai	3/IV	79.7	15.9	8	31.5	1.3	23.5
Bala Oulé(<i>O. g.</i>)	5/IV	76.5	21.7	10	21.7	1.6	3.5
Malo Ba (<i>O. g.</i>)	8/IV	71.0	19.5	6	20.2	1.8	3.0
Mouvaguin(<i>O. g.</i>)	6/IV	57.9	18.1	5	17.8	1.5	3.0
Baladjaug(<i>O. g.</i>)	4/IV	61.6	18.7	11	22.3	1.6	4.5
Kuma × Bala Oulé	4/IV	79.3	17.9	6	28.2	1.6	12.3
Ozeki × Bala Oulé	6/IV	69.6	21.1	5	33.7	1.8	12.0
Murasaki-saikan × Bala Oulé	5/IV	73.9	19.9	8	38.9	1.6	9.7
Kogane-nishiki × Bala Oulé	6/IV	79.3	22.4	6	41.3	2.0	10.5
Murasaki-saikan × Malo Ba	5/IV	65.2	19.3	6	28.5	1.4	10.3
Kuma × Mouvaguin	5/IV	66.0	14.8	7	23.5	1.3	7.0
Asahi × Mouvaguin	6/IV	63.8	18.4	6	24.5	1.9	10.3
Takasaki-mochi × Baladjaug	5/IV	80.0	20.7	5	38.6	2.0	12.0
Ozeki × Baladjaug	5/IV	63.3	19.9	7	26.9	1.8	13.0
Asahi × Baladjaug	5/IV	65.0	21.3	9	29.6	1.9	13.0
Hikari-sen × Bala Oulé	5/IV	79.6	21.4	8	39.0	1.6	20.5
Togyokusai × Baladjaug	5/IV	69.5	19.1	11	27.6	1.8	14.8
Heenati × Mouvaguin	5/IV	59.5	20.5	7	38.9	1.5	12.7

variety. The spikelets of the hybrid are even longer than the spikelet of *glaberrima*, being fairly wide or somewhat narrow (Fig. 6 and Fig. 7). The

Fig. 6. Comparison of the spikelets of Ozeki (left), Baladjaug (right) and their F_1 hybrid (middle).

Fig. 7. Comparison of the spikelets of Hikari-sen (left), Bala Oulé (right) and their F_1 hybrid (middle).

Table V. The shape of spikelets of the parents and hybrids.

	Length mm.	Width mm.	Thickness mm.	Weight mg.	Length Width
Bala Oulé	8.1	3.4	2.0	27.9	2.4
Malo Ba	8.4	3.6	2.0	31.5	2.3
Mouvaguin	8.5	3.3	2.0	28.5	2.6
Baladjaug	8.1	3.3	2.0	26.3	2.5
Ozeki	7.3	3.5	—	—	2.1
Hikari-sen	8.5	2.8	—	—	3.0
Togyokusai	8.4	3.2	—	—	2.6
Heenati	7.3	3.1	—	—	2.4
Ozeki × Baladjaug	8.7	3.3	—	—	2.7
Hikari-sen × Bala Oulé	9.2	3.0	—	—	3.1
Togyokusai × Baladjaug	9.1	3.0	—	—	3.1
Heenati × Mouvaguin	8.8	3.1	—	—	2.9

Table VI. The percentage of normal pollen-grains of the F₁ hybrids

Combination of the parents		% of normal pollen-grains		
♀	♂	Female parent	F ₁ hybrid	Male parent
Kuma	× Bala Oulé		28.9	95.5
Ozeki	× " "	93.6	11.5	"
Murasaki-saikan	× " "		25.2	"
Kogane-nishiki	× " "	89.6	17.7	"
Murasaki-saikan	× Malo Ba		3.5	97.7
Kuma	× Mouvaguin		2.2	94.8
Asahi	× " "	90.8	23.0	"
Takasaki-mochi	× Baladjaug	92.3	8.1	96.1
Ozeki	× " "	93.6	3.0	"
Asahi	× " "	90.8	10.4	"
Hikari-sen	× Bala Oulé	95.7	10.5	95.5
Togyokusai	× Baladjaug	94.5	2.0	96.1
Heenati	× Mouvaguin		0.4	94.8

Fig. 8. Twenty four somatic chromosomes in the root-tip cell of Bala Oulé (smeared; × 2,240)

Fig. 9. Twelve bivalent chromosomes in the pollen mother-cell of Bala Oulé (× 2,240)

hybrid spikelets (sterile) are more deciduous than those of the parents.

The blade of the second seedling leaf (the first leaf with blade) of *glaberrima* is rather long and wide taking tilted position to the vertical axis, and the corresponding leaf-blade of Japanese varieties, standing rather erect, is short and narrow. The leaf-blade of the hybrid is somewhat intermediate in those respects.

The ligule of *glaberrima* is short with round tip, and that of *sativa* is long and acute, the end of

which is split into two. The ligule of the hybrids is fairly long and acute, but the end is in most of the cases not split.

F₁ hybrids raised in the summer season came to flower in the end of August, and observations were made on a limited number of characteristics, such as growth type, glume-tip colour, awning, awn-colour and deciduousness. There was, however, nothing of particular interest to further describe about those observations.

Fertility :

The fertility of *glaberrima* was normal, though it fluctuated yearly to some extent. According to the observations made on the materials grown in the winter season of 1953~1954, the fertilities of the 4 varieties of *glaberrima*, Bala Oulé, Malo Ba, Mouvaguin and Baladjaug were in the same order 80.1%, 65.8%, 83.3% and 94.7%. The fertility of the *sativa* varieties used in the cross was also very high.

The F₁ hybrids of *sativa* and *glaberrima* were perfectly sterile for all combinations of parents, most of the pollen-grains being unable to develop normally. Table VI shows percentages of normally developed pollen-grains of the hybrids of different combinations grown in the winter season. So far as the observations show, the highest percentage of the normal pollen-grains was 28.9, and the lowest was below one, the average being 13.4% for the hybrids between Japanese varieties and *glaberrima*, and 4.3% for the hybrids between foreign varieties of *sativa* and *glaberrima*. The hybrids of *sativa* and *glaberrima* survived during the winter in the root stock more easily in the green house than the parental species, and the hybrids thus preserved have been under observation thereafter every year. They produced panicles every year under a short-day condition, but no seeds, so far, have been obtained from those plants.

Cytological Observations

Like *O. sativa* L., *O. glaberrima* STEUD. has 24 rod-shaped chromosomes in somatic cells, and at meiosis the chromosomes regularly form 12 bivalents (Fig. 8 and Fig. 9). Two SAT-chromosomes are clearly noticeable in the somatic metaphase. The F₁ hybrids of the two species produce at the first division of meiosis 12 bivalents, and the whole meiosis proceeds very regularly (Fig. 10). Most of the microspores thus produced, however, soon start to degenerate causing the high sterility of the hybrid.

Conclusion

O. glaberrima STEUD. cultivated in certain regions of West Africa is a species characterized pri-

Fig. 10. Pollen mother-cell divisions of the hybrids of *O. sativa* and *O. glaberrima*. a, diakinesis, Asahi $\times$ Mouvaguin ($\times 2,000$); b, heterotypic metaphase, Asahi $\times$ Mouvaguin ($\times 3,300$); c, heterotypic anaphase, Asahi $\times$ Mouvaguin ($\times 2,000$); d, interphase, Kuma $\times$ Mouvaguin ($\times 2,000$); e, homotypic metaphase, Ozeki $\times$ Bala Oulé ($\times 2,000$); f, tetrad formation, Murasaki-saikan $\times$ Bala Oulé ($\times 2,300$)

marily by its glabrous glumes. It has short ligules of round tip and short and wide terminal leaf-blades, producing long and wide spikelets. The species has 12 reduced number of chromosomes, which have perfect affinity to the 12 chromosomes found in *O. sativa* L.

According to S. RAMANUJAM, the hybrid of *O. sativa* L. and *O. glaberrima* STEUD. is highly fertile, segregating many of the characteristics in Mendelian fashion in the progeny. Thus, he concluded that it is probable that this species is only a variety of *O. sativa*.

O. glaberrima STEUD. is, no doubt, a species having the same genomic constitution (AA) as *O. sativa* L., but it differs from the latter with a series of characteristics as described above. So far as the present experiments are concerned, the

hybrid is, contrary to the observations cited, sterile which makes it rather convincing to separate the two as different species.

The ecological and agricultural characters of *O. glaberrima* are now under investigation, and it is too early to determine the value of the species as a breeding material in Japan. Glabrous nature of glumes itself may be an advantageous agricultural characteristic, but it can also be found, if necessary, in certain *sativa* varieties especially in those grown in Philippines (5). Though the hybrid is sterile under open pollination, the seed is, no doubt, obtainable by backcrossing the hybrid to either one of the parents.

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稲の細胞遺伝学的研究

IX *O. sativa* L. と *O. glaberrima* STEUD. との F₁ 雑種

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摘 要

1. 西部アフリカに於て古くから栽培される *O. glaberrima* STEUD. は一見したところでは *O. sativa* L. に似ているが、葉舌が短かく、籾に毛がなく、止葉は比較的短かくて広い点で後者とことなる。
2. *O. glaberrima* STEUD. は *O. sativa* L. との間に容易に雑種を作るが、出来た F₁ 植物は、印度に於ける実験例と趣を異にして、全く稔らなかつた。
3. *O. glaberrima* は $n=12$ の染色体をもち、これと *sativa* との F₁ 雑種は減数分裂に於て 12 の 2 価染色

体を示すから、*glaberrima* は *sativa* と同様なゲノム構成 (AA) の種である。

4. F₁ 雑種の減数分裂は正常に終了して四分子を作るが、それらから完全に見える花粉粒に発達するものの率は甚だ低い。これが F₁ 不稔の直接の原因となる。

5. *O. glaberrima* の日本に於ける育種素材としての価値についてはなお検討中であるが、特に興味をひく形質は今迄には見付かつていない。穎の無毛性は必要ならば特にヒリッピン産の *sativa* の中に容易に見出されよう。

細胞学と交雑試験によるダイアンサス属の研究 (抄録)

R. C. CAROLIN, (1957) Cytological and hybridization studies in the genus *Dianthus*. The new phytologist 56 (1) 81~97.

Dianthus 属はカーネーションをはじめ多くの園芸種を含んだ属である。この分類は 1893 年の Williams 以来幾つかの section 及び sub-section に分けて考えられてはいるが、非常に不完全であり、又雑種起源のものも多くて、現在では錯綜して来ている状態である。

ここではキューウ植物園に集められている百種以上の種 (変種、園芸種も含む) について、その染色体を調査し、又出来る限りの交雑を行つて従来の分類法に検討を加えている。

染色体数は $n=15$ を基本数とする単純な倍数性を示し、6 倍体 ($2n=90$) のものまで見られるが染色体は非常に小さく変化に乏しい。

各種の交雑難易性から見ると従来考えられていた section, sub-section にはかなり不都合の点が多く、ここではほぼ明らかな section として *Armerium*,

Barbati, 及び *Carthusiani* の 3 つが考えられた。しかしこれらに属さないものの類縁関係は倍数性も加わつてかなり複雑して来る。

地理的分布から見ると、分布が重り合っている様な種の間では稔性のある雑種を作るものが多く、遠隔地間のものでは不稔が多いが、いずれの種でも染色体の形態上の相違は見られず雑種不稔を示す様な組合せでも、meiosis における染色体の対合はかなりきれいに行なわれる。

不稔の原因は多くは胚の abortion にあるが、これは接合体における何らかの遺伝的アンバランスに基づくと考えれば、染色体の基本的部分は属を通じて殆ど変化しているものでなく、僅かな部分的な変化が各分布地区で蓄積して、これら種の相違を形作つていてのではないかと考えられる。

(東大農 伊藤秋夫)