

Oochikara: A Rice Cultivar in Japan with Large-Sized Grains

Kiyoyuki MIURA and Akira KOBAYASHI

Department of Crop Breeding, Hokuriku National Agricultural Experiment Station
(Inada, Joetsu, Niigata, 943-01 Japan)

Abstract

Oochikara is a nonglutinous rice cultivar, which was released in Japan in 1989. It is characterized by its large-sized grains, i.e. 36.0 g/1,000 grains in brown rice, which is approximately 60% heavier than the check varieties in Japan such as 21.5 g of Sachiminori and 22.3 g of Kochihibiki. Oochikara has very high yielding ability, the average yield of which was 7.17 t/ha in brown rice under the experimental conditions during the period of 1984 to 1988. It is resistant to leaf blast disease, but susceptible to bacterial leaf blight and stripe virus. Since its grain and eating qualities as a staple food are rather low, it is expected that Oochikara would be utilized as a raw material for food industry such as rice confectionery.

Discipline: Crop production

Additional key words: breeding, high yielding ability

Introduction

Improvement of yield potential continues to be one of the most important objectives of the rice breeding programs in Japan. Toward this end, rice breeders have concentrated their efforts to the improvement of agronomic characters with special emphasis placed on lodging resistance, tolerance to heavy manuring and high photosynthetic capacity, using semi-dwarf genes, one of which is allelic to *Dee-geo-woo-gen* gene. Through the rice breeding programs in the 1960s and early 1970s, several cultivars having a high yielding ability were released and contributed to the significant increase in rice production. In particular, an induced semi-dwarf mutant cultivar, Reimei¹⁾, and its derivation, Akihikari²⁾, and several other cultivars with a semi-dwarf gene from a native cultivar, Jyukkoku³⁾, have played a primary role in enhancing rice productivity and production in the northern as well as southern areas of Japan.

Since the mid 1980s, overproduction of rice has become one of the major concerns in Japan, which has been caused by an increase in yield accompanied with a gradual decrease in consumption. In the

circumstance, greater attention has increasingly paid in the breeding programs to identification of new genetic resources which could contribute to the development of wider utilization of rice grains as the materials for food industries as well as for animal feed. In pursuing such a specific objective, a group of rice breeders has been engaged in a special assignment for the purpose of developing extremely high yielding cultivars, which should be satisfactorily profitable in practical production. To achieve the envisioned goal, an increase in sink size with good ripening received the first priority in the breeding program. BG-1, a line with large-sized grains originated from a subinterspecific crossing, was selected for breeding operations, through which a new high yielding cultivar, Oochikara, was derived for release in 1989.

The present paper describes briefly the breeding process and some agronomic traits of Oochikara.

Breeding process

Oochikara originated from the progenies of crossing between BG-1 and Shu 3116 at the Hokuriku National Agricultural Experiment Station, Japan,

which took place in 1989 (Table 1). BG-1 is a line selected from the cross between Taiho and Chokoto at the National Agriculture Research Center in 1979⁴⁾. Taiho is a japonica mutant line with broad grains induced from Tozan 36, while Chokoto is a Chinese native cultivar with long, scented grains. BG-1 has grain weight of more than 50 g per 1,000 in brown rice, being very susceptible to lodging due to the weak nature of its culms. The other parent, Shu 3116, which was developed from the cross between Sachiminori and Inabawase at the Hokuriku Nat. Agr. Exp. Sta. is of short stature and stiff culm (Fig. 1).

The crossing was made with the aim of combining large grain size of BG-1 with lodging resistance

as well as other excellent characters of Shu 3116. The F₁ plants were grown in a greenhouse in the winter of 1979/80. The F₂ bulk population was planted under direct seeding in a nursery bed in 1980. In 1981, the F₃ plants, 5,150 in population size, were grown, among which 118 plants were selected in 1982. In the course of breeding operations, an F₅-line among the eight F₄-lines was identified for selection as a promising material for further yield tests. In 1984, one of the selected F₆-lines was named Hokuriku 130, which proved to possess a high yielding ability under local adaptability tests at various locations in Japan. In 1989, that line was registered as Paddy Rice Norin No. 296 and named Oochikara by the Government of Japan for public use.

Table 1. Selection records on Oochikara

Year Generation	'79-'80 F ₀ -F ₂	'81 F ₃	'82 F ₄	'83 F ₅	'84 F ₆	'85 F ₇	'86 F ₈	'87 F ₉	'88 F ₁₀
No. of line groups	Bulk			8	1	1	1	1	1
No. of lines (individuals)	Generation advance in a greenhouse	(5,150) ^{a)}	118	40	5	5	5	5	5
No. of selected lines			8	1	1	1	1	1	1
No. of selected individuals		(118) ^{a)}	40	5	5	5	5	5	5

a): Individual selections. Others are line selections.

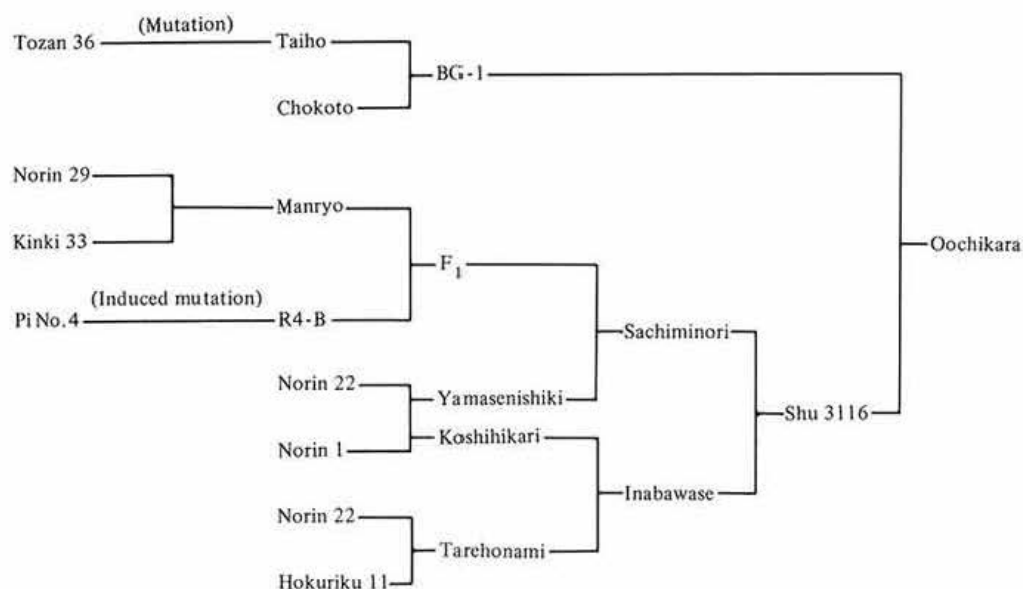


Fig. 1. Genealogy of Oochikara

Table 2. Agronomic characters of Oochikara and control cultivars

Cultivar	Heading date	Maturing date	From heading to maturity (days)	Culm length (cm)	Panicle length (cm)	No. of panicles (/m ²)
Oochikara	Aug. 10	Sept. 22	43	91	22.6	310
Sachiminori	Aug. 9	Sept. 19	41	86	18.7	451
Kochihibiki	Aug. 12	Sept. 26	45	79	19.7	506

Table 3. Characteristics of brown rice of Oochikara and control cultivars

Cultivar	1,000 kernel weight (g)	Grain appearance ^{a)}	Amylose content (%)	Grain length (mm)	Grain width (mm)	Grain thickness (mm)	Length /width
Oochikara	36.0	9.0	14.4	7.18	3.42	2.59	2.10
Sachiminori	21.5	3.5	-	5.57	2.94	2.16	1.89
Kochihibiki	22.3	4.7	-	5.37	2.92	2.19	1.83
Koshihikari	-	-	13.3	5.21	2.94	2.15	1.77

a): 1 (superior)—9 (inferior).

Major agronomic characters of Oochikara

(1) Heading and maturing habit

Heading date of Oochikara is the same with that of Sachiminori and slightly earlier than Kochihibiki (Table 2). Maturing date is about three days later than Sachiminori, a medium maturing variety at the Hokuriku region, and four days earlier than Kochihibiki, a late maturing variety there.

(2) Plant posture

Culm length, panicle length and number of panicles per m² of Oochikara are, on an average, about 90 cm, 22.6 cm and 310, respectively. Leaves are erect, and colored deep green. Culms are thick and stiff. Panicles bear a small number of large spikelets with few awn and yellow apiculus. Grains are tolerant to shattering.

(3) Grain size and quality

The 1,000-grain weight of Oochikara is 36.0 g in brown rice, which is 60% heavier than the ordinary Japanese cultivars, such as Sachiminori (21.5 g) and Kochihibiki (22.3 g) (Table 3 & Plate 1). Oochikara is the first high yielding rice cultivar which was developed in Japan under the specified breeding purpose of increasing sink size of grains. The ratio of length to width of a brown rice grain is about 2.0, which corresponds to the medium type of grain ratio of the Japanese cultivars. Oochikara has a disadvantage in grain quality as compared with the

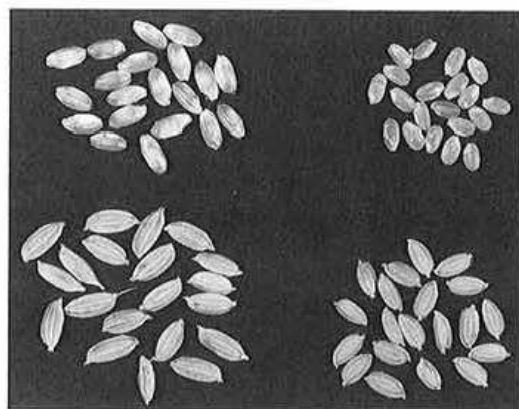


Plate 1. Unhulled rice and brown rice of Oochikara (left) and Sachiminori (right)

ordinary cultivars in Japan. The majority of its grains each have a white belly. Its eating quality as a staple food is also inferior to the ordinary cultivars. Amylose content of Oochikara is about 14%, which is the same level with other Japanese cultivars.

(4) Yielding ability

Yield tests were carried out at the Hokuriku Nat. Agr. Exp. Sta. in Niigata Prefecture, one of the rice production centers in Japan. The average yield of Oochikara under the tests at the Experiment Station undertaken in the period of 1984 to 1988 was 7.17 t/ha in brown rice, which was about 10% higher than

that of Sachiminori, a control variety (Table 4).

Performance tests were extensively undertaken at 57 locations covering the major rice producing areas of the central part of Japan during the period of 1984 to 1988. In these tests, Oochikara was compared with Nipponbare, which was selected as a common control for its wide adaptability in the concerned areas. The overall average yield of Oochikara was 6.78 t/ha in brown rice, which was 15% higher than that of Nipponbare. Based on this result, Oochikara may be rated a commercial variety which possesses the highest yielding ability among the present rice cultivars in Japan.

Resistance to diseases, pests and environmental stress

Table 5 presents resistance of Oochikara to diseases, pests and other stress.

(1) Blast resistance

The analytical study on major genes resistant to leaf blast fungus showed that Oochikara most likely possessed a *pi-ta²* gene as well as some other genes, though not identified.

Field resistance of Oochikara to leaf blast was examined in 1987 and 1988. No symptom of leaf blast was observed under the natural conditions of paddy fields. An artificial infection of selected races was

carried out in a greenhouse. The result suggested that Oochikara have higher field resistance than Nipponbare, which has intermediate field resistance to leaf blast disease.

(2) Resistance to bacterial leaf blight

Regarding the resistance to bacterial leaf blight, it was observed that Oochikara might not have any true resistance gene and that its field resistance was lower than that of Koshihikari, which has intermediate field resistance to the said disease.

(3) Resistance to rice stripe

Oochikara has no resistance gene to rice stripe virus.

(4) Resistance to planthopper

The tests on resistance to white-backed planthopper and green leafhopper indicated that Oochikara was susceptible to both planthoppers, as is the case with the other rice cultivars in Japan.

(5) Tolerance to cold temperature and sprouting

In regard to the cold resistance of Oochikara, it is lower than Koshihikari and higher than Sachiminori. Oochikara is therefore classified into the medium class in terms of cold resistance of rice cultivars. The result of the test on sprouting in an incubator showed that Oochikara was rated the easiest class among the Japanese rice cultivars.

Adaptability and utilization

Taking into account its heading and maturing time, Oochikara is expected to be grown for commercial purpose in a wide range of areas from southern Tohoku to the southernmost part of Honshu island. Such a wide adaptability was confirmed by the local tests, which covered major rice producing areas throughout the country. It was also confirmed that Oochikara would not be suited to commercial production in the low-temperature areas such as Hokkaido, northern Tohoku and highlands.

Table 4. Yielding ability of Oochikara and control cultivars

Cultivar	Total weight ^{a)} (t/ha)	Brown rice weight (t/ha)
Oochikara	17.4	7.17 (110)
Sachiminori	16.8	6.54 (100)
Koshihikari	16.1	6.43 (98)

a): Weight of the whole plants, including rice straw and grains.

Table 5. Resistance to diseases, pests and other stress

Cultivar	Disease resistance					Resistance to brown planthopper	Tolerance to cold temperature	Tolerance to sprouting
	Blast resistance major gene	Blast field resistance		Bacterial leaf bright	Rice stripe virus			
		Leaf	Panicle					
Oochikara	<i>Pi-ta²</i>	MR	-	M	S	S	M	S
Sachiminori	<i>Pi-ta²</i>	R	R	MS	S	-	MS	MS
Koshihikari	<i>Pi-a</i>	M	MR	MS	S	-	MS	M

Easy sprouting of Oochikara may also restrict its wider adaptation. In rainy areas during the harvesting season, like Kyushu, sprouting causes such serious damages to rice production that Oochikara could hardly be distributed to those areas.

Since grain and eating qualities of Oochikara are both very low, it would not be suitable for daily diet of the Japanese consumers. It is therefore expected that it would be utilized as a raw material for food industry such as rice confectionery.

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