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The New Rice Variety "Iwate-21"

— Developed by Radiation Breeding —

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INTRODUCTION

Rice, the staple food in Japan, was turned to overproduction in the latter term of 1960's. For that reason, the Japanese people have come to like rice with good eating rice quality such as cultivar "Sasanishiki" and／or "Koshihikari". In the northern part of Iwate prefecture, however, the favored varieties as mentioned above have not been cultivated because of the cool climatic conditions.

The high-yielding variety "Akihikari", which is one of the main rice varieties in this area has been cultivated even in the inadaptable area. So the damage of cool-summer due to floral impotency is gradually increasing. On the other hand, another main variety in this region, "Hayanishiki" is favorable for early maturity and lodging resistance, but the grain quality, the eating quality and the cool wheather resistance are not so good. Therefore, the rice produce in this region has been evaluated as low grade in the market, and the rice-growing farmers have desired an early maturing rice variety with good eating quality. So we had been considered that the "Hayanishiki" should be eliminated from the recommended varieties and that it should be exchanged to a new variety.

For the purpose of the improvement in the rice produce in the northern part of Iwate prefecture, we have tried to rear the new variety which is early maturing with good eating quality. Consequently, as we have raised a new rice variety "Iwate-21", we report its breeding procedure, agronomic traits and so on.

BREEDING PROCEDURE

"Iwate-21" was developed from the irradiation of the cultivar "Sasanishiki". The original cultivar "Sasanishiki" has the best eating quality, but the other agronomic traits are not so good; low lodging resistance, late maturity in the northern region of Iwate prefecture, sensitivity to blast disease and so on. The objective of irradiation was to make an early maturing variety with good eating quality from the cultivar "Sasanishiki". The irradiation to the "Sasanishiki" was done at the Institute of Radiation Breeding, NIAS, in 1979. The radiation dose given to the dry seeds of the "Sasanishiki" was 20 kR (1 kR／hour) of gamma ray (^{60}Co).

In 1979, the irradiated seeds (500g) were grown by our standard cultivation method and a few seeds (M_2) were taken from each plants. The next year (1980) , the M_2 population (about 12,800 plants) were sown and transplanted in a 5a paddy field, and then about 150

Table 1. The number of group of line, lines and individual plants to be planted and selected

	Generation (Year)							
	M_1 ('79)	M_2 ('80)	M_3 ('81)	M_4 ('82)	M_5 ('83)	M_6 ('84)	M_7 ('85)	M_8 ('86)
Planted								
Group of line				21	7	6	1	1
Line			85	48	20	12	10	10
Individual plant	19,000	12,800	1,920	800	800	240	800	800
Selected								
Group of line				5	3	1	1	1
Line			21	7	6	1	1	1
Individual plant		85	48	20	12	10	10	24

Table 2. Main characters of fixed and tested lines (1983)

Line	Heading date	Maturing date	Culm height (cm)	Panicle length (cm)	Panicle number (no／㎡)	Grain yield (kg／a)	1000 grains weight (g)
IwateNo.21	Aug.15	Sep.29	73.1	18.7	499	72.8	20.4
No.22	Aug.14	.23	85.2	16.7	430	74.5	21.9
No.23	Aug.15	Oct. 1	64.2	16.6	486	61.9	21.6
No.24	Aug.14	Sep.28	66.5	17.7	384	63.6	20.9
No.25	Aug.14	.30	64.5	18.4	371	58.2	21.4

Defect; No.22 : Grain quality blast disease resisthnce.
No.23 : Culm length, blast disease resistance.
No.24 : Grain uniformity.
No.25 : Grain quality.

plants were artificially selected from this population with good visual traits, and those plants were selected to 85 individuals.

After the individual selection in 1980, the line selections were repeated using the pedigree method as shown Table 1. Since 1983, performance test, blast disease resistance test, cool wheather resistance test, local adaptability test and other tests were executed in our breeding fields, Kenpoku Branch Agricultural Expriment Station (Karumai,Iwate) and many other Breeding Stations in Tohoku District.

Through the same process, the tested 5 lines were named "Iwate No.21, 22, 23, 24 and 25". They were all derived from a population of irradiated "Sasanishiki". In those lines, "Iwate No.21" was found to have many desirable agronomic traits and high degree of sufficient fixation as a cultivar (Table 2, 3). For those reasons, "Iwate No.21" was released as an early maturing recommended variety under the name of "Iwate-21".

Table 3. Degree of fixation

Variety and lines		Heading date	Culm length		Panicle length		Panicles		Measured individuals
			Av. (cm)	S.D.	Av. (cm)	S.D.	Av. (no./hill)	S.D.	(no.)
Iwate-21	1	Aug. 8	59.4	1.4	18.1	0.9	13.0	1.9	40
	2	Aug. 8	60.5	2.1	17.8	0.9	13.0	1.5	40
	3	Aug. 8	60.5	2.1	17.5	0.8	14.8	2.3	40
	4	Aug. 8	61 9	1.5	17.2	1.0	14.6	2.0	40
	5	Aug. 8	60.9	2.0	17.3	0.8	15.7	2.4	40
	6	Aug. 8	60.6	1.3	17.0	0.7	14.9	2.6	40
	7	Aug. 8	63.1	1.6	17.9	0.8	15.2	2.5	40
	8	Aug. 8	62.3	1.6	17.9	0.7	14.9	2.0	40
	9	Aug. 9	63.2	0.8	17.4	0.8	15.8	1.8	40
	10	Aug. 9	63.4	1.1	17.5	0.6	15.3	1.9	40
Akihikari		Aug. 9	70.8	2.2	15.9	0.9	21.1	3.3	40
Sasanishiki		Aug. 16	80.3	2.3	16.9	0.7	26.3	2.3	40

Data:1987 Av. : Average S.D. : Standard deviation

As "Sasanishiki" was grown in inadaptable site, the plant was small.

CHARACTERISTICS OF "IWATE-21"

1. Morphological Characteristics

The morphological traits of the seedling of this variety turn to high plant length of seedling, the length of which consists of that of 1st sheath and 2nd leaf.

The leaf age, colour and dry matter weight of seedling is not significantly different from the original variety "Sasanishiki" (Table 4).

Table 4. Characteristcs of seedling (24 days after seeding, 1987)

Variety	Seedling height (cm)	Leaf age	1st sheath height (cm)	2nd leaf blade length (cm)	Dry matter weight (g/indiv.)	Dry matter weight per length (mg/cm)
Iwate-21	11.8	2.2	3.24	6.88	1.11	0.94
Sasanishiki	9.5	2.2	2.88	5.81	0.80	0.84
Akihikari	11.0	2.3	3.10	6.38	1.08	0.98

After the transplanting to paddy fields, early growing vigour becomes high. This high vigour is essential as an early maturing variety in north Iwate Prefecture. But the plant posture changed into a small one on the whole. Especially, its culm is over 10cm lower than that of the original variety, but the panicle length is not so relatively shortened (Table 3, 5, 6).

Table 5. Plant typs and other visual traits

Variety	Plant type	Culm	Awn	Apiculus colour	Grain density	Degree of grain she
Iwate-21	Short culm height, partial panicle-number	Middle thick, stiff	Abent	Yellow-white	Middle	Resistance
Sasanishiki	Middle culm height, panicle-number	Slender, delicate	Little present, short	〃	〃	〃
Akihikari	Short culm height, pertial panicle-weight	Middle thick, stiff	Rare present, short	〃	Half dense	〃

Table 6. Culm and internode length (1987)

Variety	Culm length (cm)	Panicle length[2] (cm)	Ear extrusion[2] (cm)	Internode (cm) 1st	2nd	3rd	4th	5th
Iwate-21	66.6	18 3	6.0	31.6	19.3	10.3	4 9	0.4
Sasanishiki[1]	78.0	16.7	7.4	31.6	21.6	14.0	8.7	1.7
Akihikari	66.5	17.0	5.5	30.7	17.8	11.3	5.4	0.9

1) As "Sasanishiki" was grown in inadaptable site, the plant was small.
2) see Fig. 1.

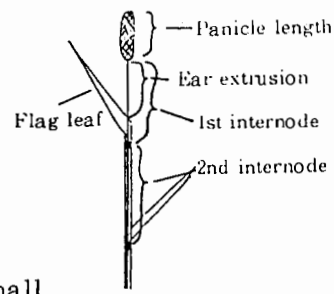


Fig. 1.

After the heading, the plant is no disturbance and fine at sight because of its shortness, strong lodging resistance, blades verticality and good colour of matured plants (Table 7, 8).

The brown rice is slightly smaller than that of the original variety (Table 9), but the its luster, uniformity and the other traits of this kind are as good as the original variety. Consequently, the grain appearance of "Iwate-21" is highly graded in quality in the northern part of Iwate prefecture (Table 10, 11).

Table 7. Growing behavior for about two months after transplanting (around maximum tiller number stage)

Site	Fertilizer application	Year	Measuring date	Iwate-21 Plant height (cm)	Iwate-21 Tillers per hill	Hayanishiki Plant height (cm)	Hayanishiki Tillers per hill	Akihikari Plant height (cm)	Akihikari Tillers per hill
Takizawa	Standard	'84	July 11	51.8	27.8	61.5	25.1	52.3	28.2
		'86	July 18	44.5	29.9	53.4	28.7	45.1	32.5
		Av.		48.2	28.9	57.5	26.9	48.7	30.4
	Heavy	'84	July 11	51.8	27.3	60.9	25.2	53.3	29.3
		'86	July 18	46.3	29.1	53.5	30.4	45.5	31.6
		Av.		49.1	28.2	57.2	27.8	49.4	30.5
Karumai	Standard	'85	July 18	57.2	24.9	60.6	24.1	55.0	26.9
		'86	July 18	46.0	22.9	50.5	24.0	44.9	26.9
		Av.		51.6	23.9	55.6	24.1	50.0	26.9
	Heavy	'85	July 18	57.7	26.3	62.1	25.0	56.6	27.7
		'86	July 18	46 2	25.8	52.2	27.1	45.6	31.0
		Av.		52.0	26.1	57.2	26.1	51.1	29.4

1) Takizawa : Iwate Pref. Agri. Exp. Stn.
2) Karumai : Iwate Pref. Agri. Exp. Kenpoku Branch Stn.

Table 8. Culm height and other traits in maturing stage

Site	Year	Iwate-21				Akihikari			
		Degree of lodging (0～5)	Culm height (cm)	Panicle length (cm)	Panicles (no./㎡)	Degree of lodging (0～5)	Culm height (cm)	Panicle length (cm)	Panicles (no./㎡)
Takizawa	1984	0	76.6	18.2	461	0.5	83.8	17.3	517
	1985	tr.	74.0	18.3	520	0.3	79.0	16.9	575
	1986	0	71.0	17.3	535	0	72.0	15.9	571
	Av.	0	73.9	17.9	505	0.3	78.3	16.7	554
Karumai	1985	0	74.6	18.5	475	0	82.1	18.7	449
	1986	0	68.8	17.6	501	0	74.8	16.0	534
	Av.	0	71.7	18.1	488	0	78.5	17.4	492

Table 9. Distribution of grain thickness (1986; %)

Site	Variety	2.2mm over	2.2～2.1	2.1～2.0	2.0～1.9	1.9～1.8	1.8～1.7	1.8mm under	1.7mm under
Takizawa	Iwate-21	2.4	23.0	47.7	16.3	8.8	1.5		0.3
	Akihikari	12.3	46.1	29.8	6.5	3.8	1.2		0.5
Karumai	Iwate-21	8.1	41.0	36.7	8.4	3.8		2.0	
	Akihikari	22.5	44.9	24.6	4.7	2.0		1.3	

Table 10. Grain size (1987)

Variety	Grain length		Grain width		Grain thickness		Length／Width	
	Av. (mm)	S.D.	Av. (mm)	S.D.	Av. (mm)	S.D.	Av. (mm)	S.D.
Iwate-21	0.49	0.016	0.27	0.010	0.20	0.007	1.79	0.082
Sasanishiki	0.49	0.015	0.27	0.007	0.19	0.007	1.85	0.056
Akihikari	0.49	0.017	0.28	0.014	0.20	0.012	1079	0.084

1) As "Sasanishiki" was grown in inadaptable site, the grain is small.

Table 11. Grain quality (produced in Takizawa)

Variety	Year	Whole grains (%)				Immatured-grains (%)				Dead-grains (%)			Damaged-grains (%)			
		Perfect	Green	Slight-cracked	Total	Green-immatured	White-belly	Others	Total	Green-dead	White-dead	Total	Serious-cracked	Distortion	Others	Total
Iwate-21	1984	41.9	3.3	28.7	73.9	7.0	1.2	2.2	10.4	5.2	0.2	5.4	5.6	3.0	1.7	10.7
	1985	53.1	5.8	3.8	62.9	13.1	1.0	0.6	14.7	6.1	0.2	6.3	0.2	10.0	6.2	16.5
	1986	66.6	5.1	9.3	81.0	10.1	1.4	0.3	11.8	2.8	0.6	3.4	1.4	0.7	1.7	3.8
	Av.	53.9	4.7	13.9	72.5	10.1	1.2	1.0	12.3	4.7	0.3	5.0	2.4	4.6	3.2	10.2
Akihikari	1984	53.0	2.3	15.6	70.9	5.0	2.0	0.2	7.2	3.2	0.4	3.6	8.9	5.6	3.7	18.2
	1985	60.1	6.5	2.7	69.3	15.0	1.0	0.6	16.6	2.9	0.0	2.9	0.5	5.9	4.8	11.2
	1986	65.3	5.7	5.4	76.4	10.2	1.3	0.0	11.5	4.3	0.4	4.7	0.3	1.9	5.2	7.4
	Av.	59.5	4.8	7.9	72.2	10.1	1.4	0.3	12.3	3.5	0.3	3.7	3.2	4.5	4.6	12.3

2．Ecological Characteristics

This variety belongs to the group whose heading and maturing date is early. Its heading and maturing date are about 10 days earlier than the original variety "Sasanishiki" (Table 12).

Table12. Heading and maturing date (Takizawa)

Variety	1983		1984		1985		1986	
	Heading date	Maturing date	Heading date	Maturing date	Heading date	Maturing date	Heading date	Maturing date
Iwate-21	Aug. 15	Oct. 9	Aug. 4	Sep. 24	Aug. 8	Sep. 24	Aug. 13	Oct. 2
Akihikari	Aug. 15	Oct. 6	Aug. 5	Sep. 27	Aug. 9	Sep. 26	Aug. 14	Oct. 6
Sasanishiki	Aug. 26	—[1)]	Aug. 11	Oct. 3	Aug. 17	Oct. 5	Aug. 22	—[1)]

1) "Sasanishiki" could not come in the maturing stage.

As mentioned above in morphological characteristics, shortened culm gives a strong lodging resistance. It has not been clearly proved that "Iwate-21" has the same culm quality as "Sasanishiki", but the lodging resistance is rather strong compared with the original variety, and as strong as "Akihikari", one of the strongest cultivars (Table 8).

Cool weather resistance of "Iwate-21" is considerably strong, and its rank is as same as the cultivar "Reimei" (Table 13, 14).

Table 13. Evaluation of cool weather resistance

(Fujisaka Agri. Exp. Branch Stn. in Aomori)

Year	Variety	Heading date	Sterility (%)	Judgment	Observational evaluation	Synthetic evaluation	Note
1984	Iwate-21	Aug. 11	74.2	△	△～×	△	△ ; medium
	Reimei	Aug. 12	74.1	△	△～×	△	× ; slight
1986	Iwate-21	Aug. 28	36.7	…	…	3～4	resistance
	Reimei	Aug. 27	39.4	…	…	4	resistance
	Akihikari	Aug. 28	62.1	…	…	6	sensitibity

Table 14. Cool weather resistance (1983 : Takizawa)

Variety	Heading date		Delayed heading (days)	Sterility	
	Inlet	Outlet		Inlet (%)	Outlet (%)
Iwate-21	Aug. 18	Aug. 17	1	19.5	5.8
Hayanishiki	Aug. 14	Aug. 12	2	38.3	9.0
Akihikari	Aug. 18	Aug. 16	2	37.0	14.9

Inlet ; water inlet part of test plot.
Outlet ; water outlet part of test plot.

"Iwate-21" has true resistance gene *Pi-a* to blast disease. It is the same gene which the original variety has, but the field resistance is stronger than that of "Sasanishiki". This strength is more considerable than that of the main early maturing varieties such as "Hayanishiki" and/or "Akihikari" in this region (Table 15, 16).

The milling percentage of this variety is high, but the embryo is easy to remain (Table17).

The viscoelasticity of boiled rice of this variety is not equal to that of the original variety, but is superior to that of early maturing variety "Hayanishiki", "Akihikari" and others (Table 18).

The eating quality is closely related to viscoelasticity, therefore, this variety has better eating quality than that of the early maturing varieties in this region, but is inferior to the original variety (Table 18, 19).

Table 15. Estimation for blast true resistance gene

(Tohoku National Agri. Exp. Stn.,1985)

Variety	Funguns strain					Estimated resistance gene
	001 T-23	003 Ken 54-20	017 1104-3	035 Cho 65-306	101 Ina 168	
Iwate-21	R	S	S	R	R	*Pi-a* : Line No. 1～5, 7～10 (Line No. 6 was estimated $a+i$, $a+k$ or $a+k^m$.)
Shin No. 2	S	S	S	S	S	
Aichiasahi	R	S	S	R	R	
Ishikarishiroke	R	R	S	S	R	
Kanto No.51	R	R	S	S	R	
Sasaminori	R	S	S	S	R	
Toyonishiki	R	S	S	S	R	

R : resistance S : sensitibity

Table 16. Field resistance of blast disease (Iwate Agri. Exp. Stn.)

Variety	Lesion area percentage (%)				Resistance gene	Synthetic evaluation
	1983	1984	1985	1986		
Iwate 21	0	6	1	17	*Pi-a*	resistance
Sasanishiki	100	47	37	67	*Pi-a*	sensitibity
Akihikari	90	12	8	20	*Pi-a*	medium

Table 17. Milling traits

Variety	100 sec.		110 sec.		120sec.		130 sec.	
	Milling (%)	Remmained embryo (%)	Milling (%)	Remmained embryo (%)	Milling (%)	Remmained embryo (%)	Milling (%)	Remmained embryo (%)
Iwate-21	93.2	41.3	92.1	39.5	92.0[2)]	38.8	91.1	9.9
Hayanishiki[1)]	93.3	37.5	92.5	26.5	91.5[2)]	17.1	91.1	10.7
Akihikari	93.5	53.9	92.8	34.3	92.7	34.9	91.8[2)]	21.8

1) : "Hayanishiki" is one of the leading eary maturing variety in this region.

2) : Milling teminal point : bran half left in the gutter of grain back.

Table 18. Hardness and stickness of boiled rice

Variety	Hardness (H)	Stickness (-H)	Hardness／Stickness (H／-H)	Note
Iwate-21	67.4	0.53	127	Good eating quality
Sasanishiki	65.0	0.61	107	H; smaller -H; larger
Akihikari	68.5	0.49	140	H／-H; smaller

1) "Sasanishiki" was produced in Kennan Branch Agri. Exp. Stn. (Esashi, Iwate)

Table 19. Test for eating quality

Date (number of testers)	Standard variety	Variety	Synthetic evaluation	Appearance	Fragrance	Taste	Stickness	Hardness
'86 Mar.7	Haya-	Iwate-21	0.56	0.22	0.38	0.66	0.09	0.89
(10)	nishiki	Akihikari	0.40	0.00	− 0.10	0.38	0.10	− 0.13
'87 Feb.6	Haya-	Iwate-21	0.48	−0.05	0.27	0.20	0.29	0.14
(22)	nishiki	Akihikari	0.10	0.05	0.00	0.05	0.00	0.33

1) Sythetic evaluation score for "Sasanishiki" was absent.

3. Yielding Ability and Yield Components

"Iwate-21" is mainly compared with "Akihikari", because the original variety "Sasanishiki" is not possible to be cultivated in this region.

"Iwate 21" has high yielding ability which produce constantly about 70 kg／a in several experiments. This yielding level is equivalent to that of high yielding variety group. In Iwate prefecture, "Akihikari" is the highest yielding variety among the early maturing varieties and "Koganehikari" is the highest among the late maturing varieties. The yielding ability of "Iwate-21" ranks the second, and it follows "Akihikari" in the earlier group (Table 20).

Table 20. Yielding ability (the hulled-rice weight)

Site	Variety	1983	1984			1985		1986	
		M.S[1]	M.S.	Y.S[2]		Y.S.		Y.S.	
		S[3] (kg/a)	S (kg/a)	S (kg/a)	H[4] (kg/a)	S (kg/a)	H (kg/a)	S (kg/a)	H (kg/a)
Takizawa	Iwate-21	72.8	71 7	67.9	79.1	67.7	69.2	72.4	76.4
	Akihikari	72.8	73.4	79.5	79 5	72.4	69.6	76.2	81.5
Karumai[5]	Iwate-21	···	···	···	···	75 3	76.5	69.4	70.6
	Akihikari	···	···	···	···	77.3	80.4	74.1	73.5

1) M.S: transplanted maturing seedling.
2) Y.S: transplanted young seedling.
3) S: standard fertilizer condition.
4) H: heavy fertilizer condition.
5) Transplanted seedling was middle aged one.

As for yield components of this variety, the numbers of tiller, panicles and spikelets per panicle are not so large as "Akihikari" and also 1000grains weight is slightly smaller than that of "Akihikari" (Table 21, 22).

Therefore it spikelets per unit area range about from 85% to 95% of those of "Akihikari". On the other hand, the percentage of ripened grains is larger than "Akihikari", about 3% to 13% higher (Table 21, 22).

Table 21. Vield components pn standard fertilizer conditions

Site (seeding)	Yariety	Year	Panicles (no./㎡)	Spikelet setting(%) 1st branches	Spikelet setting(%) 2nd branches	Spikelets per panicle (no.)	Spikelets (10^3/㎡)	Percentage of ripened grain (%)	1000grains weight (g)
Takizawa (V.S.[1])	Iwate-21	'84	435	61	39	86.5	37.6	90.5	21.9
		'85	471	···	···	85.0	40.0	79.1	21.1
		'86	499	···	···	85.1	42.5	77.5	21.0
		Av.	468	···	···	85.5	40.0	82.4	21.3
	Akihikari	'84	474	56	44	86.6	41.0	78.1	22.7
		'85	512	···	···	84.6	42.0	74.4	21.8
		'86	527	···	···	81.1	42.8	80.8	21.6
		Av	505	···	···	84.1	41.9	77.8	22.0
Karumai (M.S.[2])	Iwate-21	'85	459	62	38	87.2	41.9	84.7	21.2
		'86	454	65	35	77.6	35.2	85.6	20.5
		Av.	457	63	37	82.4	38.6	85.2	20.9
	Akihikari	'85	457	56	44	99.3	45.3	78.4	22.1
		'86	457	60	40	92.2	42.1	84.6	20.9
		Av .	457	58	42	95.8	43.7	81.5	21.5

1) Y.S.: transplanted young seedling.
2) M.S.: transplanted middle seedling.

Table 22. Yield components in heavy fertilizer conditions

Site (seedling)	Variety	Year	Panicles (no./㎡)	Spikelet setting(%) 1st branches	Spikelet setting(%) 2nd branches	Spikelets per panicle (no.)	Spikelets (10^3/㎡)	Percentage of ripened grain (%)	1000grains weight (g)
Takizawa (Y.S.)	Iwate-21	'84	461	61	39	83.7	38.6	80.6	22.1
		85	520	···	···	87.0	45.3	68.5	21.0
		86	535	···	···	84.3	45.3	78.3	21.4
		Av.	505	···	···	85.0	43.1	75.8	21.5
	Akihikari	'84	517	53	47	92.1	47.6	71.3	22.7
		'85	575	···	···	82.0	46.3	66.7	21.9
		86	571	···	···	89.0	50.9	76.7	21.9
		Av.	554	···	···	87.7	48.3	71.5	22.2
Karumai (M.S.)	Iwate-21	85	475	60	40	98.3	42.5	85.0	21.2
		'86	501	66	34	86.7	43.4	78.9	20.7
		Av.	488	63	37	92.5	43.0	82.0	21.0
	Akihikari	'85	475	56	44	100.7	49.2	73.7	21.9
		'86	534	61	39	91.6	48.9	74.1	21.1
		Av.	505	59	41	96.2	49.1	73.9	21.5

DISCUSSION

It has been recognized that the rice variety which has important traits such a early maturity, high resistance to blast disease, cool weather tolerance and lodging resistance is not good in rice quality. Recently, however, the new developed rice variety which have both good quality and other useful traits, is beginning to make their appearance (Abe et al. 1984 Ishizumi et al. 1974;). Especially, the rice varieties which are grown in Hokkaido and the northern Tohoku District are necessary to have both good quality and cool weather tolerance (Wada et al. 1986).

In north and middle north Iwate prefecture, the early maturing varieties, "Hayanishiki" , "Akihikari" and others, have been cultivated (Fig. 2). Among these varieties, the two main varieties have not so high resistance against the cool weather in booting stage (Hirano et al. 1973; Kushibuchi et al. 1974). Therfore the cool weather damage have been frepuently brought about (Fig. 3) and it led to the decrease of rice yield and grain quality was deteriorated by immaturity. Moreover, as "Hayanishiki" has short proper time of havesting, lagging of harvesting work causes annually rusted and cheked rice.

By the above two causes, the rice grain produced in this region are left low in the inspection grade (Table 23). If a new variety "Iwate-21" is exchanged for a cultivar "Hayanishiki", it would be possible and moreover should be promoted that this variety are exchanged to the adaptable area of "Hayanishiki" and to a part of the cultivated area of "Akihikhri" , which is suppsoed to be an inadaptable area for growing it. Then the cool weather damage of caused "Hayanishiki" and "Akihikari" to be cultivated would be deceased and the rice grain quality of "Hayanishiki" would be raised by the new variety "Iwate-21".

It has been recognized that raising of commercial rice variety by radiation breeding is difficult. Actually, only a few rice varieties have been developed directly in this method (Toda et al.1984), and only one variety was developed in the Tohoku District(Toriyama

et al. 1964). Besides rice plant, a few other crop variety which was developed directly by radiation breeding in the Tohoku District (Laboratory of Soybean Breeding 1970 ; Sato et al. 1982).

Since 1979, we have carried out rice improvement by radiation breeding and tried to develop a rice variety from directly radiated mutant. Our breeding objectives was to shorten and reinforce the culm of "Sasanishiki" , and to make the heading time earier without losing the good grain quality and eating quality. We could nearly attain the expected result by making "Iwate-21" with early maturing, cool-weather resistance and so on. However, its grain quality declined slightly and the variety has some defects ; so short culm, the slightly small grain size and son on. In the selected lines from radiated mutants there are only a few lines left and we were obliged to stop examining other lines because of some defects as showed in Table 2.

In rice breeding, we should mainly adopt conventional cross-breeding and utilize other breeding techics as a supporting method, including radiation breeding. The radiation breeding should be adopted to make crossing parents with some specific characters, as many rice breeders have insisted on.

Table 23. Inspection grade of grain quality (% of each grade)

Region	1984				1985				1986			
	1st grade	2nd grade	3rd grade	Out of grande	1st	2nd	3rd	Out	1st	2nd	3rd	Out
Ninohe	52.8	43.2	3.5	0.5	47.2	44.6	7.4	0.8	14.0	37.3	46.0	2.7
Iwate	71.5	26.0	1.7	0.8	64.5	28.2	5.7	1.6	66.6	23.3	8.0	2.1
Morioka	76.4	20.0	2.2	1.4	70.5	22.4	4.7	2.4	75.1	19.4	3.3	2.2
Pref. Av.	72.5	22.8	2.7	2.0	77.1	17.4	3.3	2.2	79.8	14.2	4.0	2.0

Data: from Iwate Food Office

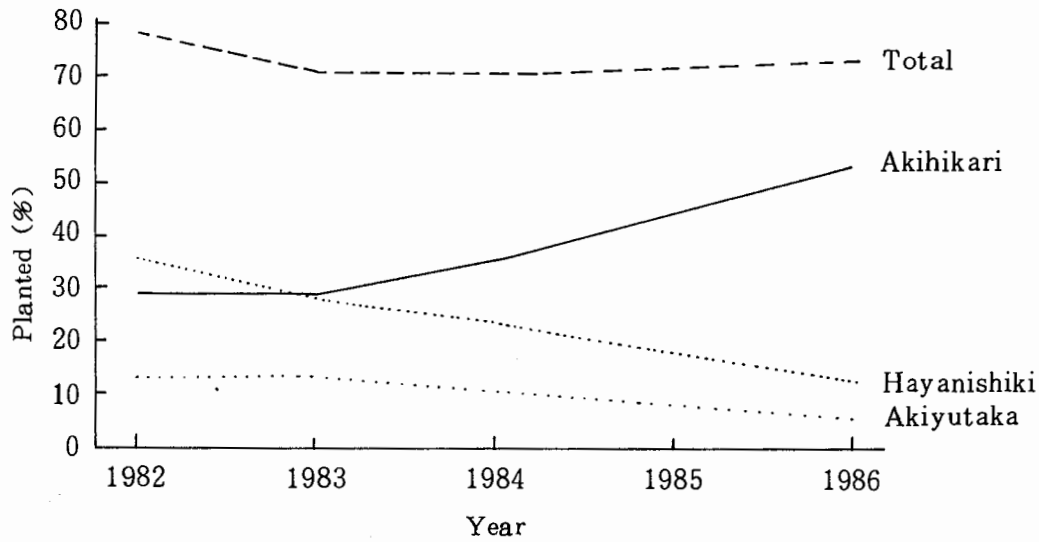
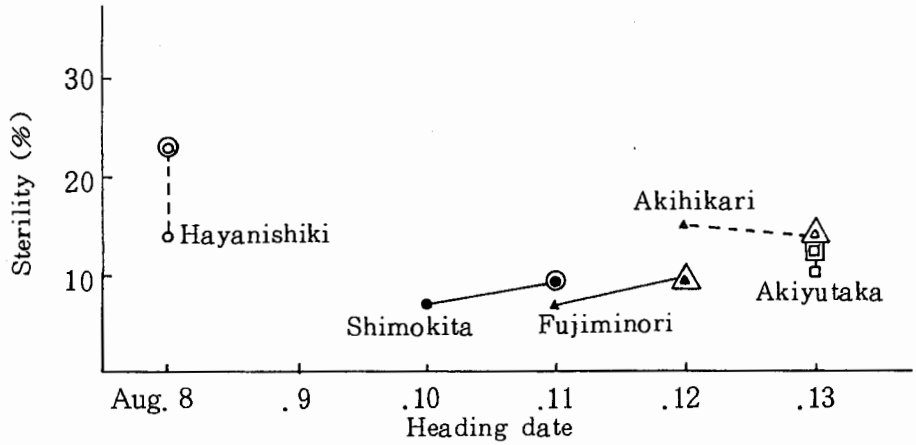
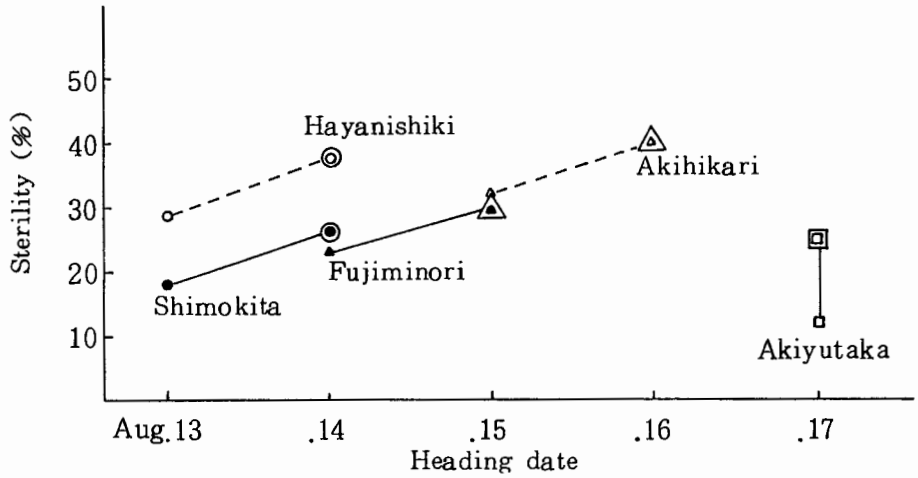


Fig 2. Planted percentage of main early varieties in north Iwate Prefecture (estimated by Iwate Food Office)



(Kenpoku Branch Agri. Exp. Stn. 1979)



(Kenpoku Branch Agri. Exp. Stn. 1982)

single dot : standard bertilizer condition
double dot : heavy bertilizer condition

Fig 3. Sterility ratio of main varieties in north Iwate Prefecture
(data : from the Report of Rice Cool Damege in 1979, 1982)

SUMMARY

1. We could develop a new rice variety from radiated mutants. This variety was named "Iwate-21". and released as a recommended variety in north Iwate prefecture.

2. This variety has many desirable traits ; early heading and maturing time, high lodging resistance, cool weather tolerance, good grain quality and so on.

3. We suppose that this variety can contribute to the stable rice production for good rice quality and decrease in cool weather damage.

4. The radiation breeding is not very efficient method, because a radiation mutant can not acquire many useful characters at once. The radiation breeding should be utilized as one supporting technics.

ACKNOWLEDGMENT

The authors wish to express our thanks to the breeders the Institute of Radiation Breeding, Tohoku National Agricultural Expriment Station, Fujisaka Branch Aomori Agricultural Expriment Station and Furukawa Agricultural Expriment Station for thier considerable advices and some tests for this varety's traits.

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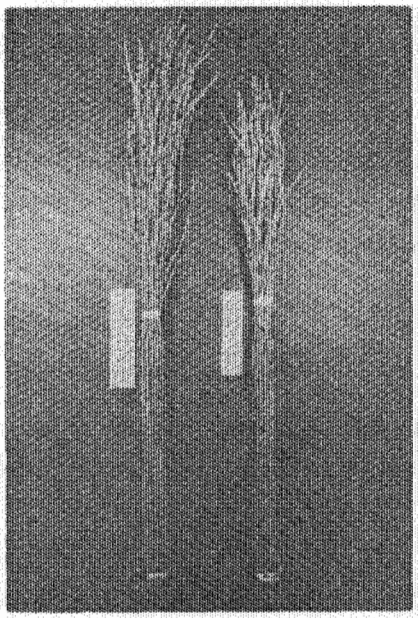

Fig 4. Plant posture of "Sasanishiki" (L) and "Iwate-21" (R).

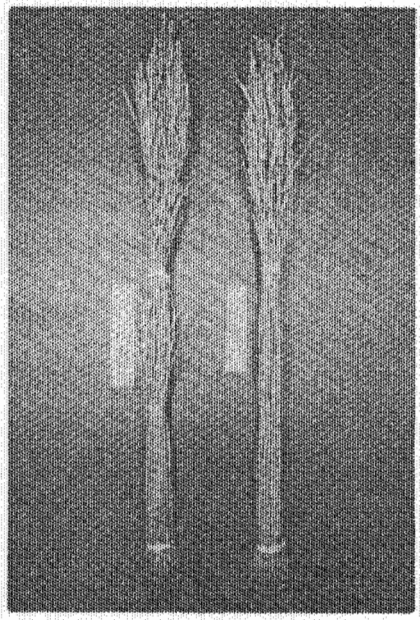

Fig 5. Plant posture of "Sasanishiki" (L) and "Iwate-21" (R).

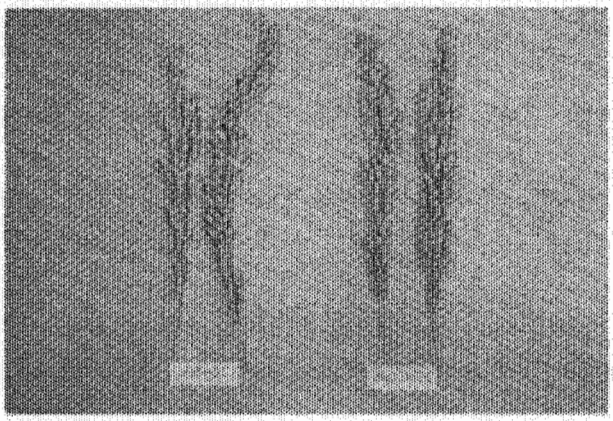

Fig 6. Ear of "Iwate-21" (L) and "Akihikari" (R).

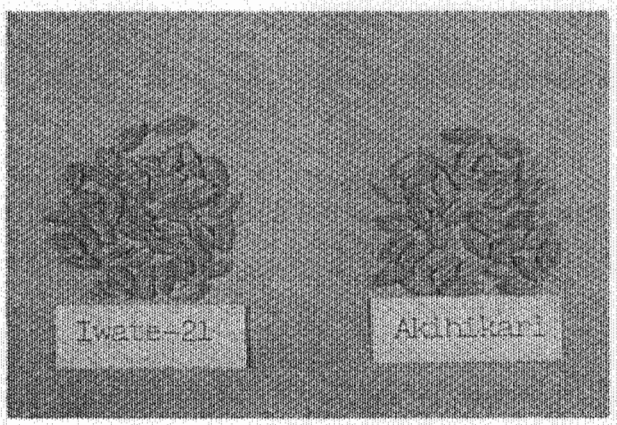

Fig 7. Rough rice of "Iwate-21" (L) and "Akihikari" (R).

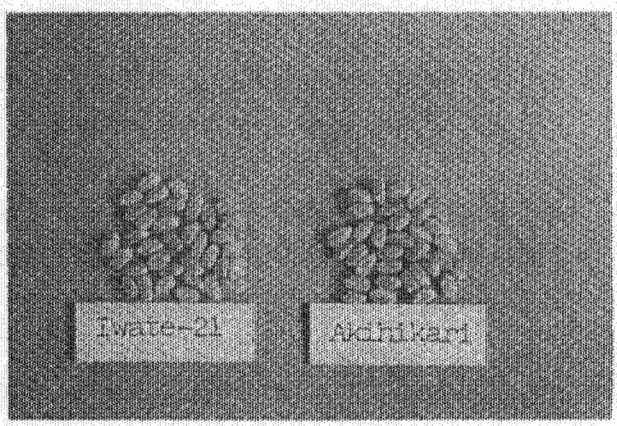

Fig 8. Brown rice of "Iwate-21" (L) and "Akihikari" (R).

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Bull. Iwate-ken Agric. Exp. Stn. 27：25 － 39（1988）

水稲新品種「いわて21」

—放射線育種による—

石川　洋・佐藤忠士・上野　剛・新田政司
木内　豊・佐々木力

摘　要

1．ササニシキの放射線突然変異より，新品種〝いわて21〞が育成された．この品種は昭年62年より岩手県の奨励品種として本県北部に普及された．

2　この品種は早生であり倒伏低抗性・耐冷性・良質などすぐれた形質を有している．

3　この品種を普及することによって，本県の北部，冷害常襲地帯における，良質米の安定生産を図ることができる．

4．〝いわて21〞は放射線突然変異育種法により育成されたが，この育成を通じてこの育種法の難しさが認識された．今後放射線突然変異育種は，交雑育種の補助的手段として利用して行きたい．