Breeding of a New Sweet Potato Variety, Minamiyutaka, by the Use of Wild Relatives

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Many indigenous varieties had been used as parents of hybridization in the sweet potato breeding in Japan. However, from the view point that the deficiency of wider gene sources for improvement of yield and quality will result in a limited efficacy of breeding in future, introduced varieties of sweet potato have been used as the breeding materials with an aim of incorporating new genes into native varieties since 1952. Koganesengan is a new variety developed from the combination between native and introduced varieties in 1966. In addition, collection of wild species related to sweet potato started in 1955 and quite a lot of species and strains had been tested for crossability to sweet potato and for specific characters. Apparently, all wild relatives show non-tuberization and have no economic value by themselves. Therefore, agronomic characters such as yield and quality must be transferred to and accumulated in the hybrids between sweet potato and wild relatives by backcrossing F_1 to sweet potato as the recurrent parent. Other characters such as resistance to diseases or pests, resistance to drought, and particular growth habits are introduced from wild relatives. A new cultivar Minamiyutaka was released in 1975 as the first variety developed by using wild relatives in Japan. Followings are breeding objectives and procedures adopted for the breeding of this new cultivar.

Objectives and procedures of breeding

As stated above, Koganesengan is a variety developed in 1966 from the combination of native and introduced varieties. The variety showed higher yield and higher starch content than those of Norin No. 2, which had been a leading variety in the southwestern part of the country for industrial use. As a result, Koganesengan replaced the area of cultivation of Norin No. 2 from 1970 and it covered more than 30% of the total sweet potato area of the country in 1971. However, the variety is not superior with respect to the storage quality and the resistance to nematodes, and cultivators demand the improvement of these two characters. As there are some wild relatives showing high resistance to root-knot nematode (*Meloidogyne* spp.) and root-lesion nematode (*Pratylenchus* spp.) the utilization of the resistances of wild relatives was attempted.

From the result of experiment on crossability between sweet potato and wild relatives, species of the section *batatas* genus *Ipomoea* were classified into two groups. Group 1 which is able to be crossed with sweet potato includes K123, K177, K221, K222, K233 and K300 and group 2 which is impossible to be crossed with sweet potato includes K61, K121, K134 and K270. The accession numbers, name of species and other characteristics of the tested genetic stocks belonging to this section are shown in Table 1. Among them, K123 (which was collected in Mexico and identified as *Ipomoea trifida* by Nishiyama in 1955) had been used as the parent for crossing with sweet potato varieties, because of its high resistance to root-lesion nematode. Up to date, 18 strains had been bred using K123. Names

Table 1. Accession numbers, names of species and other characters of tested plants in section *batatas* genus *Ipomoea*

Polyploid	Accession No.	Species	Place of collection	Chromosome No.	Grossability with sweet potato
Diploid	K61	*I. lacunosa*	U. S. A.	30	—
	K121	*I. triloba*	Mexico	30	—
	K221	*I. leucantha*	Mexico	30	+
Triploid	K222	*I. (trifida 3x)*	Mexico	45	+
Tetraploid	K134	*I. gracilis*	Mexico	60	—
	K233	*I. littoralis*	Mexico	60	+
	K270	*I. tiliacea*	Puerto Rico	60	—
	K300		Ecuador	60	+
Hexaploid	K123, K177	*I. trifida*	Mexico	90	+
	IB63001—5	*I. (trifida 6x)*	bred at Ibusuki	90	+

Remarks: 1) Names of species were idenfified by Nishiyama and Teramura.
2) Crossability: + possible to cross
— impossible to cross

Table 2. Names and characteristics of strains using K123 as the parent

Names of strains	Cross[1]		Using generation	Resistance to disease and pests[2]		
	Female	Male		R. K. N.	R. L. N.	B. R.
Kyushu 58	Kanto 48	LM17	B_1	R[3]	R	R
Kyushu 60	I 95—57	Ariakeimo	B_2	R	S	M
Kyushu 61	I 95—193	N7—1095	B_2	R	R	R
Kyushu 63	I 95—193	Koganesengan	B_2	R	M	M
Kyushu 64	I 95—193	Kyushu 52	B_2	R	R	S
Kyushu 65	I 95—193	Kyushu 52	B_2	R	R	R
Kyushu 66	I 95—193	Kyushu 44	B_2	R	R	S
Kyushu 67	I 95—193	Kyushu 44	B_2	R	M	R
Minamiyutaka	Koganesengan	Kyushu 58	B_2	R	R	M
Kyushu 70	Koganesengan	Kyushu 58	B_2	R	R	S
Kyushu 71	Koganesengan	I47—31	B_2	R	R	S
Kyushu 72	I 410—6	Koganesengan	B_1	R	S	M
Kyushu 73	I 410—6	Koganesengen	B_1	R	M	M
Kyushu 74	Koganesengan	NR510—59	B_3	R	R	S
Kanto 73	I 95—193	Kanto 41	B_2	S		R
Kanto 75	I 95—193	Kanto 41	B_2	M		R
Kanto 80	Kyushu 58	Kurimasari	B_2	S		S
Kanto 84	Chikei 19—4646	Kyushu 58	B_2	R		R

Remarks: 1) LM17: L—4—5 × K123—11, I 95—57 and I 95—193: Kanto 48 × LM17, I 47—31: S106—468 × I 116—139, I 410—6: I 116—139 × I 116—35, I 116—35 and I 116—139: Kyushu 34 × K177—2
2) R. K. N.: root-knot nematode, R. L. N.: root-lesion nematode, B. R.: black rot
3) R: resistant, M: Medium, S: susceptible

Table 3. Characteristics of Minamiyutaka

Name of varieties	Yield kg/a	Starch content %	Eating quality	Storage quality	Resistance to disease and pests		
					R. K. N.	R. L. N.	B. R.
Minamiyutaka	420	23.7	good	well	R	R	M
Koganesengan	353	24.7	good	bad	M	S	S
Norin 2	285	22.1	medium	medium	R	S	M

Remark: 1) R. K. N., R. L. N., B. R., R, M and S: cf Table 2

and characteristics of these strains are shown in Table 2. Of these strains, one was developed from the generation of three-times backcross, 14 were from two-times backcross and 3 were from one-time backcross to sweet potato varieties as the recurrent parent.

Hybridization between Koganesengan and Kyushu 58 was made in 1966. Koganesengan, the female parent, shows, as stated above, high yield, high starch content and wide adaptability to the warm region of this country. Kyushu 58, the male parent, was a selected strain from B_1 generation between K123 and sweet potato. This strain possesses high resistance to nematodes, good shape of tuberous root, and high activity of absorbing roots, though yielding ability is low. As a result of repeated selections for performance, starch content, physiological characters and resistance to nematodes and black rot with the progeny of this cross, one promising strain Kyushu 68 was obtained. This strain was distributed to several prefectural experiment stations in the western part for the regional adaptability test from 1972. In 1975, Kyushu 68 was registered as a new variety for industrial use and named Minamiyutaka. This name means high yielding ability in the southwestern part of this country.

Characteristics of Minamiyutaka

The sprouting habit is as good as Koganesengan. The color of leaf is dark green, though top leaf is purplish-brown. The vine is also purplish green in color and thick. Tuberous roots are fusiform and medium in size and skin is yellowish-brown in color with a good shape and appearance. The flesh is light yellow color and starch content is higher than Norin No. 2 but a little lower than Koganesengan. The yield is higher than Koganesengan in the southern part but not so much in the northern part. Such a difference is considered due to the varietal difference in the response to temperature and this variety needs higher temperature than Koganesengan to get the high yield. Characteristics of this variety are shown in Table 3, in comparison with Koganesengan and Norin No. 2.

Future of breeding by using wild relatives

For the breeding of recent sweet potato varieties, introduced varieties and wild relatives have played an important role. In the case of Minamiyutaka, it is believed that the resistance gene for nematodes was introduced from K123. Whenever wild relatives are used, however, sweet potato should be used as the recurrent parent in backcrossing, so as to eliminate undesirable characters of wild parent and to accumulate the yielding ability of sweet potato cultivar.

As to the number of backcrosses, the one-time backcross seems to be not enough to transfer the yielding ability from the sweet potato varieties, and two-times backcrosses appear to be good enough for this purpose.

The starins which were backcrossed two-times did not exhibit twining slender stems, and their morphological characteristics were almost similar to those of sweet potato. From this result, it is recommended that two-times backcross of K123 to sweet potato is necessary to breed an economical variety of sweet potato.

Besides K123, several other species are able

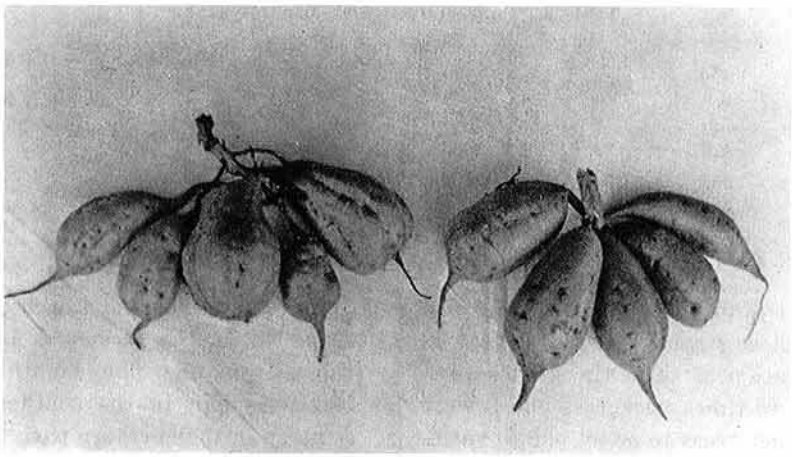

Plate 1. Tuberous roots of newly released cultivars
Left: Koganesengan
Right: Minamiyutaka

to be crossed with sweet potato directly or through the bridge plant. Some of these wild relatives possess useful genes particular to each species, but none of them possess many useful genes in one species. To incorporate these characteristics into one species, it was attempted to make interspecies crossing among different species. Already hybridizations between 3 or 4 species of wild relatives were made and strains were selected from the progenies of these interspecific hybrids. Some strains have been used as parental materials in crossing with sweet potato.

Promising selections will be obtained from the above progenies and some strains will be tested for many practical characters to breed new superior cultivars in future.

References

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