Progress of Apple Breeding in Japan

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Introduction

In 1872, the Japanese Government imported 75 apple varieties from the United States of America including Ralls Janet and Jonathan which have been cultivated as two leading commercial apple varieties in Japan up to the present time. After that time Japan has imported about 900 apple varieties from foreign countries including McIntosh Red, Golden Delicious, Starking Delicious, Redgold, Jonagold and so on[11]. Since their introduction in 1872, apple has become the second leading fruit crop, next citrus, with about 60,000 hectares of area producing about one million tons annually in Japan[3].

There is considerable interest in the development of new apple varieties that are better suited to the Japanese preference; sweet, tree-ripened fruit and good keeping quality than many of the "old" American varieties which constitute much of the present acreage.

During the past five decades more than 50 new apple varieties have been developed and released by Japanese horticulturists. Most of these varieties were produced from controlled crosses by plant breeders at two research stations located in northern Japan; one is the Aomori Prefectural Apple Experiment Station located at Kuroishi City in Aomori Prefecture and the other is the Morioka Branch of the Fruit Tree Research Station of the Ministry of Agriculture and Forestry located Morioka City in Iwate Prefecture. In addition, a few apple varieties have been developed by private orchards.

Breeding programs in the Aomori Apple Experiment Station

In 1928 the apple breeding program was started and up to 1934, 5,267 hybrid seedlings derived from 194 crosses using 50 parent varieties were nursed. After long term selections Mutsu and other three varieties were released in 1948, Megumi, Orei and other eight varieties in 1949, Aori #1 in 1953, Toko in 1963[4], Aori #2 (Tsugaru) and Aori #3 in 1970[1,2,9], Sekai-ichi in 1974[10]. Among them, Mutsu, Megumi, Orei and Tsugaru (Aori #2) were registered with their variety name respectively

The second apple breeding program was started in 1952 and up to 1960, 7,133 hybrid seedlings derived from 206 crosses were nursed. Two strains of Starking Delicious × Tsugaru-#6 were released in 1969 and Tsugaru × American Summer Pearmain-#9 in 1971 for the trials. The third apple breeding program was started in 1970 nursing over 10,000 hybrid seedlings. This program had two purposes of improving early season varieties such as McIntosh Red and American Summer Pearmain and improving late-keeping variety such as Ralls Janet.

Breeding programs in the Morioka Branch, Fruit Tree Research Station

Systematic apple breeding, aimed at the improvement of fruit qualities and acquisition of resistance to diseases, was established in 1939 at the Morioka Branch of Fruit Tree

Research Station. Breeders at an early stage of that breeding program made 42 crosses among 18 varieties and raised 4,656 hybrid seedlings. They selected Tohoku #7 from 596 fruit beraing hybrid of Ralls Janet × Delicious in 1958. It was named as Fuji and registered by Ministry of Agriculture and Forestry in 1962[5]. Another variety was seletced from hybrid seedlings of Jonathan × Worcester Pearmain as Tohoku #3 in 1953. Tohoku #3 was named as Akane and registered by Ministry of Agriculture and Forestry in 1970[6]. One selection of J.G-39 (Jonathan × Golden Delicious) was named as Hatsuaki and registered as an early to middle sesaon variety in 1976.

The second apple breeding program was started in 1959 making 4,665 hybrid seedlings from 144 cross combinations and selected '4814018' for the trials in 1968. The third apple breeding program was started in 1969 using some Australian and New Zealand varieties as a cross parent and obtained about 5,180 hybrid seedlings derived from 67 crosses made with the objective to breed early maturing variety[11].

New varieties derived from private orchard

Although there are no systematic breeding program in private orchards, a new variety, Kinsei was developed from the cross of Golden Delicious × Ralls Janet, and was registered in 1972. This was the first registered variety developed by a private apple grower[7].

Change of cultivated varieties in the apple orchard

As listed Table 1[8,12], a total of 13 new

Table 1. The main apple varieties developed in Japan

Variety	Season	Color	Cross	Location
4814018	Early	Red	Tohoku #2 × Redgold	Morioka
Akane	Early	Red	Jonathan × Worcester Pearmain	Morioka
Hatsuaki (J.G-39)	Middle	Red	Jonathan × Golden Delicious	Morioka
Fuji	Late	Red	Ralls Janet × Delicious	Morioka
Tsugaru (Aori #2)	Early	Red	Golden Delicious × ?	Aomori
Mutsu	Middle	Yellow	Golden Delicious × Indo	Aomori
Orei	Middle	Yellow	Golden Delicious × Delicious	Aomori
Sekai-ichi	Middle	Red	Delicious × Golden Delicious	Aomori
Megumi	Late	Red	Ralls Janet × Jonathan	Aomori
Toko	Late	Yellow	Golden Delicious × Indo	Aomori
Kinsei	Late	Yellow	Golden Delicious × Ralls Janet	Private
Indo	Late	Red-brown	Chance seedling	Private
Orin	Late	Yellow	Chance seedling or possibly Golden Delicious × Indo	Private

Table 2. Percentage distribution of apple vareities grown in Japan (1973 data, Ministry of Agriculture and Forestry)

	Old varieties[a]	Delicious (Starking D.)	Golden Delicious	Mutsu	Fuji	Others[b]
Actual data (1966)	68	16	7	1	1	7
Estimated data (1985)	15	31	5	3	34	12

a : Including McIntosh Red, American Summer Pearmain, Ralls Janet and Jonathan.

b : Including Tsugaru (Aori #2), Redgold, Jonagold and so on.

varieties have been bred so far by the national research station, prefectural experiment station or private apple growers. They have attracted grower's attention and their acreage has been increasing. However, at the present time 4 varieties, McIntosh Red, American Summer Pearmain, Ralls Janet and Jonathan, that were imported from the United States of America nearly 100 years ago comprise about two-third of the total apple acreage. Various Delicious sports and Fuji varieties have been planted extensively in recent years and Table 2 indicates that the acreage of Delicious strain (mainly Starking Delicious and spur type sports) will double in the next few years with a corresponding decrease in the "old" varieties. Of the varieties developed in Japan, Fuji and Mutsu are currently the most popular with growers, especially Fuji would become a most leading apple variety in the near future[12].

Some varieties bred in Japan become to be grown in foreign countries, for example Mutsu variety renamed as Crispin in Europe and the culture of this large triploid variety is now increasing in Europe and the United Kingdom. Akane also renamed as Primrouge in France, and Prime Red in the United States of America.

Brief description of a variety Fuji[5]

Fuji is a progeny bred from the cross between Ralls Janet and Delicious. The fruit quality of Fuji is much improved from that of Ralls Janet, the most typical variety for the late-keeping apple having poor texture and quality. Taste and flavor of Fuji are just like those of Delicious and no apple have been more juicy, firm and keep well. These merits are enough to fill up any defect of this variety. Therefore, Fuji begins to be widely planted instead of Ralls Janet in the apple growing districts of Japan as shown in Table 2.

Fruit; Large, round oblate or oblong and averages 250–300 g. Skin is thick, tough and smooth. Color is just like standard Delicious but not so attractive. Flesh is very firm, a little coarse, very juicy, aromatic and pleasantly subacidic just as Delicious. Quality is very good to best as a dessert apple. It matures in early or middle November and keeps well till late April (Plate 1).

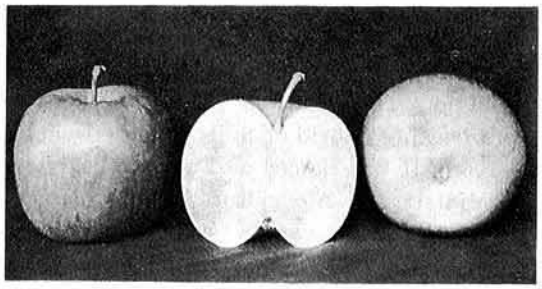

Plate 1. Fruit of Fuji

Plate 2. Original tree of the variety Fuji Crossing was made in 1939, Photographed 15th August, 1975 (36 years old tree)

Tree; Spreading, large, vigorous, healthy, productive and annual cropping. It comes to bearing by five to six years old. It blooms three to five days later than Jonathan. Preharvest drop and June drop are very few. The original tree is still standing in the orchard of the Morioka Branch, Fruit Tree Research Station (Plate 2).

References

1) Aomori Apple Experiment Station: The original color illustration of new apple varieties (1951).
2) Kon, K.: Description of new apple varieties bred in Aomori Apple Experiment Station.

Aomori Apple Exp. Sta. (1950) [In Japanese].
3) Mink, G. I.: The apple industry in Japan. *Hort. Sci.* 8(2), 81–86 (1973).
4) Miura, J. et al.: New apple variety 'Toko'. Spring Meeting of the Japan. Soc. Hort. Sci., 5, (1963) [Abstr. In Japanese].
5) Sadamori, S. et al.: New apple variety 'Fuji'. *Bull. Hort. Res. Sta. Japan*, Ser. C, No. 1, 1–5 (1963) [In Japanese with English summary].
6) Sadamori, S. et al.: New apple variety 'Akane'. *Bull. Hort. Res. Sta. Japan*, Ser. C, No. 8, 1–7 (1973) [In Japanese with English summary].
7) Suzuki, C.: New apple variety 'Kinsei'. *Kajitsu Nihon*, 27(3), 60–61 (1972) [In Japanese].
8) Yamada, M.: Color illustration of new apple varieties. *Tech. Bull. Aomori Apple Association*, No. 2, 1–73 (1971) [In Japanese].
9) Yamada, M.: New apple variety 'Aori #2'. Autumn Meeting of the Japan. Soc. Hort. Sci., 52–53 (1973) [Abstr. In Japanese].
10) Yamada, M. et al.: New apple variety 'Sekai-ichi'. Autumn Meeting of the Japan. Soc. Hort. Sci., 1–2 (1974) [Abstr. In Japanese].
11) Yoshida, Y.: Present status of apple breeding in Japan. *Agr. & Hort.* 49(11), 1367–1373 (1974) [In Japanese].
12) Yoshida, Y. & Mink, G. I.: Japanese apple varieties. *Fruit Varieties J.*, 26(1), 7–8 (1974).