

## Apple Cultivars— Current Situation and Future Trends in Japan

ROBERT A. NORTON<sup>1</sup>

### Abstract

Apples are the second leading fruit crop in Japan, with about 132,000 acres (54,000 ha.) of area and 1 million tons (48 million boxes) annually. The majority of the production is on the northern portion of the main island of Honshu. Commercial apple production derived from cultivars first introduced in 1872 from the U.S., e.g. 'Ralls Janet,' 'Jonathan,' 'Golden Delicious' and 'Starking Delicious.' During the past five decades, more than 50 cultivars have been developed by public and private horticulturists. Some, such as 'Mutsu' and 'Akane' already have become popular in other areas of the world. At present, 'Fuji' represents about 50% of Japanese production, followed by 'Delicious' strains 19%, 'Tsugaru' 12%, 'Orin' 5%, 'Jonagold' 4%, 'Mutsu' 3%, 'Jonathan' 3%, and 'Senshu' 2%.

'Fuji' is expected to stabilize in production, with continued attention to mutations of better color, earlier maturity or spur habit. Other cultivars of current interest are 'Sansa,' 'Tsugaru,' 'Senshu,' 'Orin,' 'Hokuto' and 'Jonagold.'

### Introduction

Although the apple originated in the Caucasus region of Asia, its introduction to Japan came primarily from the United States, through the importation of apple cultivars starting in 1872 (5). Apples now are second only to citrus in production, with about 132,000 acres (54,000 hectares), located mostly on the northern half of the main island of Honshu (6).

Apple breeding and cultivar development are conducted primarily at two research stations—the Aomori Prefectural Apple Experiment Station and the Morioka Branch of the Fruit Tree Research Station of the Ministry of Agriculture, Forestry and Fisheries. Small breeding and evaluation programs are located at other research stations. Considerable small scale breeding and selection is done by private individuals, some of whom

have been quite successful in introducing commercial cultivars (1, 2).

The author has made three trips to Japan in—1984, 1987, and 1989—specifically to study fruit germplasm, particularly apples. After the first trip, an article was prepared for the *Fruit Varieties Journal* describing the current status of Japanese cultivars (2). The second trip provided an opportunity to limit the focus of promising cultivars from 32 down to about 8 that seem to have distinct commercial potential for North America. The 1989 trip was primarily to study strains of 'Fuji' and to develop contacts and procedures for legal importation of new cultivars for evaluation in the northwestern United States.

### Current Situation

The acreage and percent of each apple cultivar in Japan are shown in Table 1.

Since 1986, 'Fuji' has continued to increase and is now almost 50 percent of the total acreage, a factor which is causing some concern. On the most recent visit, we noted that 'Delicious' and its strains were consistently lowest priced in the wholesale market. The highest prices are paid for fruit grown in paper bags. ('Delicious' and 'Golden Delicious' are seldom bagged.) 'Mutsu' is most commonly grown in this manner, often with Japanese symbols (good luck, long life, etc.) etched into the skin by means of etiolation (restricting sunlight from portions of the fruit). Fruit of this type was being sold as high as \$300 per box (44 pounds) wholesale. 'Delicious' in the same market was going at \$21. (Note: Most U.S.

<sup>1</sup>Department of Horticulture, Washington State University, Mount Vernon, Washington 98273.

Table 1. Apple cultivars in Japan (1986).

Cultivars	Year Introduced	Acreage	Percentage
Fuji	1962	52,968	40.2
Starking Delicious	1872	20,016	15.2
Tsugaru	1975	15,552	11.8
Orin	1952	6,840	5.2
Red Delicious strains	Var.	5,280	4.0
Jonagold	1968	5,016	3.8
Mutsu	1949	4,224	3.2
Jonathan	1872	3,816	2.9
Senshu	1980	3,288	2.5
Golden Delicious	1872	1,968	1.5
Others		13,032	9.9

growers would be happy with this price.)

Table 1 also shows that, with the exception of the American cultivars introduced years ago, many of the prominent cultivars are of relatively recent origin, and all are from breeding programs, public or private. In 1969 the National Fruit Research Station at Morioka cooperated with Dr. Don McKenzie of New Zealand in a breeding program to combine traits of Japanese and New Zealand germplasm. The cultivar 'Sansa' was introduced in 1987 as a result of this effort (3). 'Sansa' is patented in the United States but not assigned to any particular nursery at this time.

Since 'Fuji' is such a dominant cultivar in Japan and promises to increase rapidly in other parts of the world, some of its assets and liabilities should be noted here. 'Fuji' has many strong points—excellent sweet flavor with a sugar content from 14-20%, firm juicy texture, good size, smooth finish, annual production when properly managed, and absence of preharvest drop. As prominent Washington grower Grady Auvil says, "It is an apple that doesn't fool you. It doesn't look good on the outside when it's poor on the inside."

On the other hand, 'Fuji' is late maturing. In the primary production district of Japan, Aomori, they don't start to pick until about November 9. In more southerly areas such as Nagano prefecture, northwest of Tokyo (latitude 36.7°), it may be picked about October 20. Furthermore, the 'Fuji' tree is not particularly "grower friendly." It has a growth habit not unlike 'Granny Smith' but entirely different for spur 'Delicious.'

'Fuji' is a cross of 'Ralls Janet' and 'Delicious.' While the 'Ralls Janet' contributed assets such as firmness and shelf life, it probably also passed on the characteristics that cause the greatest concern in growing this cultivar—deficient color and late maturity. In its original state, 'Fuji' ranges from a pale pink to an intense pinkish red on fruits totally exposed to high light and cool night temperatures. Standard 'Fuji' grown in the San Joaquin Valley of California can look like an entirely different apple than Washington grown 'Fuji.' Herein lies the almost feverish interest in redder and/or earlier ripening strains.

There may be as many as 100 red-colored sports of 'Fuji' tested in Japan. Perhaps a dozen of these have made their way to North America (4). The following sports have been virus-indexed in Canada and have been legally imported into the United States:

Fuji Redsport #1

Fuji Redsport #2

Fuji Redsport Nagano #1

An early maturing sport of 'Fuji' known as 'Yataka,' has been imported and patent applied for by a California nursery. Trees are not yet available for commercial sale.

A number of other strains of 'Fuji' and other Japanese varieties have entered the country without being indexed and released by the USDA-Animal and Plant Health Inspection Service (5). These are now undergoing testing and virus heat treatment under the IR-2 program at Prosser, Washington.

ton. Some of these cultivars will be made available within 1-3 years when this work has been completed.

### Tsugaru

A 'Golden Delicious' cross released in 1975 from the Aomori Station. 'Tsugaru' ripens about 10 days before 'Gala,' and has wide, light red stripes over a yellow-green ground color. It has a mild, sweet flavor and juicy, tender flesh. The standard variety may not color well enough under our cultural conditions, but several strains such as 'Homei,' 'Natsuka' and 'Beni Tsugaru' have distinctly better color.

### Senshu (Sensyu)

'Toko' x 'Fuji' released from Akita Prefecture in 1980. 'Senshu' appears to be one of the more popular new varieties in Japan. It ripens with 'Gala,' is red striped with firm, juicy flesh of excellent quality, good shelf life, and storage capability. It is doubtful that 'Senshu' will be able to compete with 'Gala' where the latter can be well grown.

### Orin

'Golden Delicious' x 'Indo,' developed by an apple grower from Fukushima Prefecture. 'Orin' is a late-maturing 'Mutsu'-type apple, i.e. yellow-green in color with prominent lenticels. It ripens about one week before 'Fuji' or two weeks later than 'Delicious.' Excellent quality and shelf life, but probably would be successful only in long-season, arid climates where russet is not a problem.

### Hokuto

'Fuji' x 'Mutsu' cross from the Aomori Apple Research Station released in 1983. 'Hokuto' is a large, red dessert apple ripening with 'Jonagold' and 'Golden Delicious.' It is a triploid. The Japanese hold high hopes for 'Hokuto' because of its extremely high quality. On the negative side, 'Hokuto' is susceptible to moldy core and may have color problems if not well exposed.

### Other Japanese Varieties Under Test in Washington

It should be emphasized that at present all of the Japanese cultivars, except those specifically noted as being available, are under strict quarantine until they are rendered free of harmful viruses. Notification will be given to nurseries when the cultivars are available for propagation. The following are being indexed and simultaneously evaluated for commercial potential in Washington:

Ambitious	Nebuta
Kogetsu	Scarlet
Kogoyoku	Shizuka
Kotoku	Takane
Michinoku	Yoko

### Literature Cited

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### Fingerprints for 'Delicious' Sports

Isozyme electrophoresis has been used successfully to characterize and separate apple cultivars but closely related cultivars are difficult to separate. A new technique using DNA fingerprints was tried on 15 different sports of 'Delicious.' These sports exhibited almost identical fingerprints. Thus this technique may be successful in differentiating between cultivars devised through genetic recombination but not useful for differentiating vegetative sports.

From Nybom, H. 1990. DNA Fingerprints in Sports of 'Red Delicious' Apples. *HortScience* 25(12):1641-1642.