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'Fuji' Apple

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In 1939, the first apple breeding programme was established at the Morioka Fruit Tree Research Station as a program of the Ministry of Agriculture, Forestry and Fisheries. In 1958, Tohoku No. 7 was selected from 596 fruit bearing hybrids of 'Ralls Janet' (♀) and 'Delicious' (♂). This selection was named 'Fuji' and registered by the Ministry of Agriculture and Forestry of Japan in 1962. The name 'Fuji' was a commemoration of the town of Fujisaki in the Aomori Prefecture where the crosses and selections were made. The original tree (Fig. 1) is still standing in the orchard of the Morioka Branch, Fruit Tree Research Station. The original strain is not highly colored, but many red coloring strains have been found. 'Fuji' fruits are medium to large size, firm, crisp, very sweet and very juicy. Fruits develop slightly roughened skin, have a subacid flavor and are very good dessert apples. Fruit is round-oblate or oblong, and mature in early or mid-November in Morioka and often have water core (Fig. 2). Trees are large, spreading, vigorous and productive, but susceptible to biennial bearing.

Cultivation

Fruit quality and color of 'Fuji' on M.9 were superior to 'Fuji' on *M. prunifolia* when trees were grown in a volcanic ash soil (20). 'Fuji' on M.9 fruited 1 or 2 years earlier than trees on *M. prunifolia*. The tendency toward biennial bearing was less with M.9 than with *M. prunifolia*. Yield of 'Fuji' on M.9 was higher than that on M.26. Fruit size, soluble solids and flower bud formation tend to decrease as trees mature (20). 'Fuji' trees can become biennial bearing if overcropped. Early fruit thinning to one fruit per five terminal buds and 75 leaves per fruit resulted in adequate return bloom and good fruit size. 'Fuji' is difficult to thin, even with young trees. Ethephon sprays at full bloom give satisfactory thinning for 'Fuji' (10), but cause excessive russeting.

Maturation

As harvest is delayed, fruit weight and soluble solids of 'Fuji' apples increase and firmness, titratable acids, starch and total pectin decrease (12). During a 7-day after harvest period at 20°C, soluble solids increased and titratable acid decreased, but firmness was unchanged. The slow rate of firmness loss by 'Fuji' apples is in contrast to rapid rates of loss exhibited by many other apple varieties (23). Ground-color and red surface color as determined by color charts have been used as maturity indices in Japan (22). 'Fuji' apples have low ethylene evolution, internal ethylene and low respiration rate during ripening (11, 23). Although 'Fuji' apples contained appreciable amounts of 1-aminocyclopropane-1-carboxylic acid (ACC) just after harvest, ethylene evolution was not detected (23).

Storage

Controlled atmosphere (CA) storage (0-1°C, 3-4.1% O_2 and 1.5-2.8% CO_2 for 187 days) of slightly unripe 'Fuji' was successful for long-term storage (17). Internal browning was observed after 6 months of cold storage with greater incidence in more mature apples (17). Fruit stored in regular cold storage have greater weight loss than fruit

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Figure 1. Original seedling tree of 'Fuji' (Tohoku No. 7) at the Morioka Branch, Fruit Tree Research Station in Japan.

stored in CA. CA storage also maintains acidity in 'Fuji.' 'Fuji' remained in a firm ripe or crisp condition, even after a warm treatment at 20°C for 30 days, while other cultivars became overripe and mealy (6). Fruit in 1% of CO_2 had less internal browning than fruit in 3% CO_2. Early harvested 'Fuji' had superficial scald after 7 months cold storage at 0°C (4), but fruit stored at 0°C for 8 months in low pressure storage at 40 or 80 mmHg maintained good quality (16). Fruit stored at 725 and 160 mmHg showed core browning after long-term condition after 2 or 3 months at 10°C (18).

Diseases and Disorders

Watercore: 'Fuji' develops severe watercore if harvested late. Since Asian consumers like watercored apples, these fruits command high prices. Watercored fruits do not store well due to internal breakdown. A single beam of 810 nm light can be used to determine the incidence of watercore (7, 8). Watercore appeared in both the core and the flesh area of 'Delicious' but only developed in the core area of 'Fuji' (8).

Corebrowning: 'Fuji' apples have peculiar browning disorders referred to as 'Core-line Browning' and 'Inner-

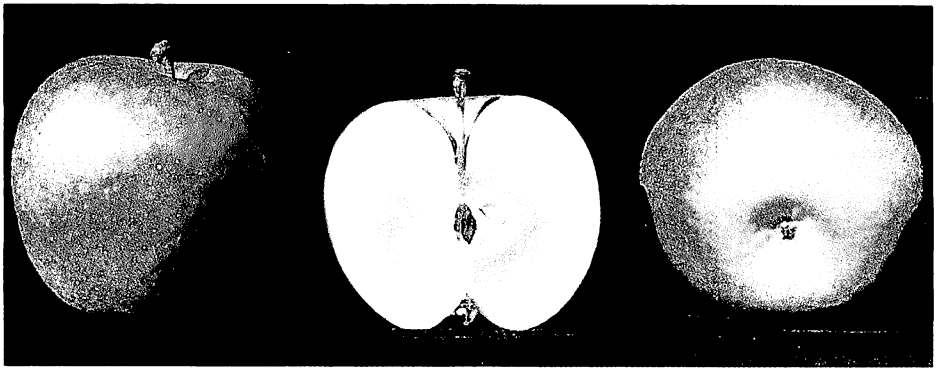

Figure 2. Fruits of 'Fuji' showing watercore around core (center).

core Browning' (5). The incidence of core-line browning tends to increase with increasing watercore. Watercore of 'Fuji' remains longer in the core line region than in other areas. The incidence of inner-core browning was not related to watercore intensity. However, a relation between the occurrence of this disorder and watercore was suspected, because the inner core area is the last part which is affected by watercore during storage. In a Japanese study, pre-harvest calcium sprays caused an increase in core-line browning and scald (5).

'Fuji' apples are susceptible to several other diseases and disorders. Russet ring is a graft-transmissible virus (21) reported in Japan. Temperature affects symptom expression, with daytime temperatures higher than 20°C resulting in suppression of symptoms. Apple fruit crinkle, also graft-transmissible, showed symptoms on 'Fuji' after dry fall weather (13). 'Fuji' is very susceptible to bitter rot (*Glomerella cingulata* Stoneman) (3). Cork spot, bitter pit and a vanadate-sensitive ATPase related to bitter pit were found in 'Fuji' (9). 'Fuji' leaves seemed to have less susceptibility to *Alternaria mali* Robert than 'Starking Delicious' (24). 'Fuji' is also very susceptible to mucor rot caused by *Mucor piriformis* (14).

Commercialization

'Fuji' quickly became an important cultivar in Japan (Fig. 3) and its culture was associated with the dramatic decline in acreage of 'Ralls Janet' and 'Jonathan.' 'Fuji' has also become a major variety in Korea and Brazil (1). Although introduced to the USA in the early 1960's, 'Fuji' has achieved wide popularity only in recent years. In the last 5 years, about 619,000 'Fuji' trees have been planted, and a considerable number of existing trees have been top worked to 'Fuji' in Washington State (2). It is estimated that another 2.21 million 'Fuji' trees were sold in 1991 and 1992 and that the production of 'Fuji' in Washington will approach several million boxes by the end of the century. California will have 8,000 to 10,000 acres of 'Fuji' by 1995. California production could reach 7 million boxes in the next several years (15). These production increases will make 'Fuji' one of the major apple varieties in the USA.

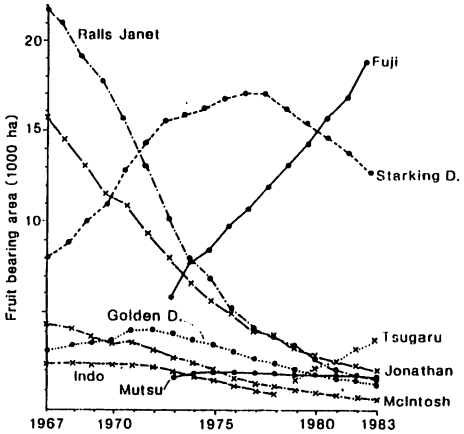

Figure 3. Changes in fruit bearing area of apple cultivars in Japan.

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